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ABSTRACT

These eight units of instruction are the products of a project conducted at Burlington County College in Pemberton, New Jersey, to develop three-dimensional computer graphics units of instruction for use in courses designed to train students in the areas of architectural, civil, drafting and design, and electronics technology. Addressed in the individual instructional units or packets are the following topics: beam selection, loop traverse calculations, foundation footings, retaining walls, computer-aided schematic drawing, computerized specification writing for architectural projects, architectural specifications on a computer, and listings and specifications for all divisions of building specifications. Each unit contains some or all of the following: a title page outlining information concerning course content and timing, goals, a rationale, objectives, learning activities, an assignment, evaluation criteria and activities, a bibliography, sample printouts and program diagrams, a homework assignment, and answers to the homework assignment. (MN)

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ED250512

FINAL REPORT
OF
PROJECT CURRICULUM DEVELOPMENT
FOR THE 3D MICRO COMPUTER LAB/
CIVIL TECH., ARCH. TECH., DRAFTING
AND DESIGN TECHNOLOGY
SCDG 430

1983-84

BURLINGTON COUNTY COLLEGE
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This project reported herein was conducted pursuant to a contract from the New Jersey Department of Education, Division of Vocational Education and Career Preparation. It was funded under Section 133 of Public Law 94-482.

Project Duration: 11/01/83
Beginning Date

6/30/84
Ending Date

The Contractors undertaking this project were encouraged to express fully their judgments in professional and technical matters. Points of view or opinions do not, therefore, necessarily represent official funding agency positions or policies.

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FUNDED UNDER SECTION_____ OF P.L. 94-482

PROJECT TITLE: Curriculum Development for the 3-D Micro-Computer Lab/ Civil Tech./Arch. Tech./ Drafting and Design Technology Tech.

LEGAL NAME OF APPLICANT DISTRICT, INSTITUTION OR AGENCY: Burlington County College

ADDRESS: Pemberton-BrownsMills Rd.
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PROJECT DIRECTOR: David C. Bryenton

TELEPHONE NUMBER: 609-894-9311, E335
(Area Code)

ABSTRACT

DESCRIPTION OF PROJECT

(Use this sheet and no more than one other to type in single-spaced form a statement of project objectives, procedures that were followed, state and local priorities emphasized and the expected contribution of the project to vocational education.)

Recent developments in computer electronics have brought computer graphics and computer aided drafting & design into the affordability of county colleges in the form of micro-computer software and hardware.

Several companies in Burlington County are now asking for computer graphics skills in their two year graduate new hires and established employees. This proposal would be a first step in supplying these firms with employees having the computer graphic skills they ask for.

The objectives of this proposal are: a. to develop 8 units of instruction through the medium of computer graphics and computer aided drafting/design (CADD); and b. to supervise the purchase, installation, and debugging of a small computer graphics lab to help accomplish objective a.

The eight units of instruction from eight different courses will involve three instructors from the fields of Architectural Technology, Civil Technology, Drafting and Design Technology and Electronic Technology. Each unit will include: a. written goals, rationale, objectives, homework, testing, and evaluation sheet; and b. computerized classroom examples and demonstrations. (Additional parts of each unit would be computerized in a second year proposal).

Funding for the equipment for the above laboratory was requested for the N.J. State Dept. of Vocational and Technical Education in March 1983, under the proposal, "3-D Microcomputer Laboratory for Civil Technology, Architectural Technology, Drafting/ Design Technology and Graphics Design Curricula."

BEST COPY AVAILABLE

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A. Introduction

1. Problem: for at least ten yeats now, large automotive and aircraft companies have had large computers to perform 3D computer graphics, which is a "spin-off" development from digital computers which allows the operator to picture, manipulate, and design an object on the computer readout screen (CRT).

Recent developments in computer electronics have now allowed the development of 3D computer graphics at the more inexpensive microcomputer level, allowing county and community colleges to afford the equipment.

The problem is to develop 3D computer graphics units of instruction in the areas of Civil, Architectural, Electronic, drafting & Design Technology (in eight courses, involving three instructors), to suit some of our companies in and around Burlington County, who are looking for computer graphics skills in their new two-year graduates and their established employees.

2. Objectives:

A. To write 8 units of instructional material in eight different courses using computer graphics as the medium for learning, invyolving the Project Director and two other instructors. The courses, topics and instructors are listed in Appendix, A1.

B. To supervise the purchase, installation, and debugging of a 3D microcomputer laboratory consisting of up to nine student computer stations and peripheral equipment. The second objective would be the responsibility of the

2. Objectives, cont.

Project Director.

3. Related Background Information: It was abundantly evident from reading literature in the fields of computer technology and engineering technology that computer graphics is a large, rapidly developing technological phenomena.

The reasons for this are the ability of the computer to: a. store mass amounts of data, b. to do repetitive work rapidly, and c. to do interactive design or computer aided design (CAD) in conjunction with a trained operator.

Our Advisory Committee encouraged us to develop instruction in this area. (Appendix A2)

At least four companies in the county - Inductotherm, RCA Moorestown, Transamerica Delaval, and International CAD/CAM are looking for computer graphic skills in their new hire two year graduates and in their established employees.

At the Annual Meeting of the American Society for Engineering Education (1983), which is the philosophical body which studies and published reports on engineering and engineering technology, covering the U.S. and Canada, during five days of sessions, 14 were concerned directly with computer graphics or the implementation of microcomputers in technical education.

Many of the above sessions and papers list sample curricula in engineering technology, and showing how computer graphics is now being introduced at institutions around the country.

3. Related Background Information, cont.

In summary, the evidence cited shows that computer graphics is rapidly being introduced into many engineering, engineering technology, and drafting technology curricula around the country, due to industrial demand.

B. Report Body, 1. Product Produced.

Below is a list of the production of this grant.

Course	Topic	Table I	Instructor
EGR203	Loop Traverse Calculations[1]		Bryenton
DDT105	Beam Selection[1]		Bryenton
DDT106	Retaining Wall Design[1]		Bryenton
DDT106	Footing Design[1]		Bryenton
DDT103	Beam Selection[1] (Same as 105)		Bryenton
ELE152	Computer Aided Schematic Drawing[1]		Braun
DDT104	Architectural Specifications[1] on Computer		Sechleer

Copies of these materials accompany this report.

Several of the topics above have been changed from the original grant due to the availability of user-friendly software in that area and to the lack of accessable and affordable software as originally listed, (Appendix A1)

Two units of instruction originally listed are missing due to:a. The delayed delivery of hardware and software, and b. a family, out-of-state emergency which cost the Project Director about three weeks of development time. (These units were for courses DDT110 and DDT111. See Appendix A1) Development continues on these instructional units.

One unit of instruction for DDT101 was replaced with a more available and accessable unit for DDT104, as shown above.

Note: (1) Copyright releases are being negotiated for commercial software used in each instructional packet.

B. Report Body, 1. Product Produced, cont.

Of the six instructional packets produced, only the ELE152 produces significant graphical output. The two units still in development: DDT110 and DDT111 will even produce actual 3D drawings of small mechanical objects. All of the other instructional units involve graphical output but the software in the proper package could not be found to do so. Therefore, this writer drew the diagrams in his units by hand and required the students to draw the graphical output as part of their homework.

Developing the software to produce the above mentioned graphical output was beyond this writer at this point in his training, but would have been a valuable development. Hopefully, this will be achieved in the future.

Comparing Tables I and II shows the substitution, mentioned above, eliminating topics where proper software/hardware packages could not be found, and substituting instead very <u>appropriate</u> topics available in suitable hardware/software packages. The treatment of material in all the instructional packets chosen seems excellent and will be kept in the various curricula, hoping to add or find computerized graphical additions described above, in the near future.

B. Report Body

2. Findings.

Early in the grant period (11-1-83 to 6-30-84), the grant participants found out that: 1) programming instructional materials, especially graphical materials was extremely time consuming for relative beginning programmers and 2) there was no way we could develop or program original instructional materials from scratch.

Simultaneously, the field of computer software started producing a lot of "user-friendly" software, which required no programming language (i.e. BASIC, FORTRAN) to operate. Consequently, all of the instructional units submitted with this report and for this grant are units written around one or more commercial (and copyrighted) software programs.

Importantly, copyright release is <u>still</u> being negotiated with the three firms involved: a. Disco-tech Co. a Division of Morton Technologies inc., b. Micropro International Corp. and c. Spectrum Software Inc.

The "user-friendly" software chosen to be used in this grant were all relatively easy to use compared to program generation from "scratch". The problem is, however, to find software to suit your purpose that is affordable, available, and that fits your hardware, once it's purchased.

The evaluation of the software is only begun. So far, two programs have been presented to our advisory Committee and one program has been demonstrated to one class. Both presentations were demonstrations only, and received general audience approval. Student hands-on evaluation needs to follow for more

B. Report Body

2. Findings, cont. definitive evaluation.

Objective B. could not be fully achieved, since the requested state funding for a nine machine lab did not materialize in the 1983-84 FY. However, the College did fund the purchase of a DEC Rainbow microcomputer including: CPU, CRT, Keyboard, and Printer; as well as an IBMPC with CPU, CRT, Plotter, Printer, and graphic Digitizer for the purposes of helping complete this grant. Seven software programs were also purchased by the College. (The College has been awarded a grant in FY85 to further enlarge this small laboratory.)

3. Finding Interpretations: a. There's a lot of "user-friendly" software out these to be found and used, if the hardware match can be made. b. Many programs are being re-written in Microsoft (TM) to play on IBM hardware. (All of the DEC programs ordered for this grant (with outside funds) are"now" available in Microsoft (IBM) from the same software company, at a nominal charge, since the original programs were purchased from the same company. c. Computer hardware and software production is a swift moving field and an instructor could stay in awe of the phenomina forever. Upshot, the instructor must "jump in" now, acquire some software to suit his/her purpose, acquire compatable hardware, perhaps learn a language and then "go with the flow", i.e. find computer packages to suit apporpriate course topics and introduce these computerized units to the students as time and resources allow. Don't wait - the perfect hardware/software/language combination cannot be found.

B. Report Body

4. Dissemination Activities: a letter describing the computer graphics units of instruction will be sent to all of the appropriate departments at sister county colleges in New Jersey. b. College course description have been changed starting with the 1985-85 edition but are unavailable in print as of this writing. County wide advertising is done in the class schedule bulletin which comes out before each semester.

5.Eliminating Sex Bias and Stereotyping: The number of women enrolled in Architectural Technology, Civil Technology, and Drafting and Design Technology is about 20% of student majors in these fields. Current procedures for student recriutment without sex bias include: 1) A Spring workshop at the college for high school students - this year (1984)- specifically for women - on Architecture and Architectural Technology, Engineering and ENgineering Technology done by faculty in these majors, 2) high school visitations done by the Office of Business, Industry, and High School Relations, and 3) student group visitations to the college done by the Office of Community Services. The recruitment in all three areas is conducted strictly along non-sex bias and non-sex stereotyping lines.

C. Summary

1. Conclusions: a. User-friendly software (if available) allows the instructor to concentrate on the course principles with a minimum intrusion of the phenomena called computer. b. User-friendly software saves the instructor much time in producing an effective learning package, as opposed to program-

C. Summary, cont.

ing a learning package from "scratch". c. However, it is apparent that some fields like engineering and engineering technology desire their students to take at least one computer language and to be able to program problem solutions using computer language. These fields are largely allied to the technologies spoken of here. d. As I see it, user-friendly software is a "natural" in introducing the student to the computer in a problem solving way that takes the awe away, perhaps in the freshman year. In the sophomore year, naturally, more difficult programs would be tackled by the student. For the student to perform more programming here would be a natural extension. The extent of the programming will vary with software, hardware, time, and other resources available. e. When an instructor can't find software s/he wants to use, the programming will have to be done by the instructor. One hopes that institutions provide the time and resources necessary. (It takes from 50-300 hours for a mature programmer to produce a finished instructional program, by several estimates.) f. Another benefit to using commercial industrial programs which are used in the same form in industry to solve problems is in giving the student a taste of how they do it "out there".

2. Recommendations: a. Always shop software first, if possible. b. Try for user-friendly software, requiring no programming language, if possible. c. Fit the computer into each topic (where appropriate) as a natural problem solving tool. Don't force it. d. Provide funds and time for faculty

C. Summary, cont.

2. Recommendations, cont. to first learn the computer themselves and then produce computerized learning packets when and where proper resources are available.

Bibliography

See each individual instructional packet for separate bibliographies.

APPENDIX A1

Table II

Course	Topic	Instructor
DDT110	Orthographic Projection	Bryenton
DDT111	Auxialiary View Projection	Bryenton
EGR203	Developing Topological Maps	Bryenton
DDT105	Cyclical Beam Design (Steel)	Bryenton
DDT106	Cyclical Beam Design (Concrete)	Bryenton
DDT103	Steel beam Bending and Shear Stress Diagrams	Bryenton
ElE152	Printed Circuit Board Design	Braun
DDT101	Site Planning, Floor Plans, Traffic Patterns	Denchak[1] Sechleer

Note: (1) Mike Denchak left Burlington County College in December 1983 before completing work on this instructional unit. He was replaced by Larry Sechleer in January 1984, who was offered and completed this unit of instruction.

MEMO (Appendix A2)

To: Walter Croft, Alan Leary, Nicholas Mozzachio, Harry Newman and Larry Sechleer

From: Dave Bryenton, Associate Professor, Coordinator of Engineering/ Architecture/Drafting and Design Technology DB

Re. Minutes of the May 12, 1984 Drafting and Design Technology Advisory Committee Meeting

Date: May 12, 1984 (Page 1/2)

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1. Meeting called to order at 10:00am.

2. Members present: Croft, Leary, Newman, Sechleer, Bryenton.

3. Guests present: a. Mr. Rudy K. Lampi, Supervisor, Graphics Dept., Inductotherm Corp., Indel Ave. Rancocas, New Jersey 08073.
b. Mr. Lynwood Thomas, Supervisor, Engineering Services, Transamerica Delaval Corp., Florence, New Jersey 08518.
c. Mr. Ed. T Barry, Supervisor, CADAM Services, J.J. Henry Co. Inc. West Park Drive, Mt. Laurel Industrial Park, Moorestown, N.J. 08057.
d. Mr. John Wall, Manager of Information Systems, Burlington County College.
e. Dr. Connie Churchill, Chairperson, Division of Math, Science and Technology, Burlington County College.
f. Mr. Jack Braun, Associate Professor, Electronic Technology, Burlington County College.

4. Agenda: a. Progress report on New Jersey State Department of Education, Voc., Grant No. SCDG-430, entitled "Curriculum Development for the 3D Microcomputer Laboratory for Civil Tech., Arch. Tech., and Drafting and Design Technology."
b. Demonstration of the materials for two learning units were given - 1) Beam Selection and 2) Writing Architectural Building Specifications.
c. General discussion was held on the two topics listed above. The slaient points developed were as follow:

1) Companies would like graduates with computer skills to be familiar with several machines or the "generic" computer.
2) The emphasis of the computer training should be to use the computer as a tool to make decisions.
3) The college, at this time, has hopes of acquiring a VAX-750 mini-computer in the not too distant future, which would enable the areas of technology to use sophisticated software in the computer graphics area. Until a mini- computer and the software becomes available at Burlington, we shall have to experiment, innovate and move ahead using micro-computers. (Over)

MEMO, To: Advisory Comm. Members, From: Bryenton, Re: Min. of 5/11/84 Meeting, Page 2/2.

Item 4c. cont.

4) The development of computer hardware and software are a very fast moving field driven by electronic developments.

5) The principles of technology courses must be learned first, in general, befor the student is exposed to using the principles on the computer. This is to stiffle the idea in many beginning student's minds that the computer is some kind of magic box which will allow them to sidestep learning the basic principles.

6) The "zoom" capability would be a useful feature in graphical computer work.

7) CADD, i.e. computer assisted drafting and computer assisted design are becomming more important areas for concentration of studies now. CAM, computer assisted manufacturing will follow closely behind.

8) In architecture, at the present time, it was felt that business applications and possibly 2D design capability were desirable training skill, with 3D skills more important in large companies.

9) Much "user friendly" computer software is currently becomming available.

10) Larger firms don't want the "user friendly" aspect to be overdone. (User friendly software requires little or no language like BASIC or FORTRAN in its operation.)

11) Since the computer is so prevalent in industry, the colle(s) must get the student in the frane of mind to use and be comfortable with them.

12) Three dimensional software used on micro-computers will probably be "trivial" for a while compared to mini and main frame capabilities.

13) Uploading and downloading from micro-computers to mini and main frame units would be a valuable attribute.
Much software is available, usually at nominal cost through user societies.

14) The difference in skills desired in the new-hire in large firms as compared to small firms was noted. The larger firm often has a short training program for their own computer, while small firms need graduates to learn to use the computer equipment and software available more on their own, informally.

5. The meeting adjourned at 12:30pm. Attendees were invited to luncheon at Vincentown Diner and Restaurant.

CC: Dr. Harmon Pierce, President of the College
Dr. Connie Churchill, Chairperson of Math, Science & Technology Division
Mr. John Wall, Manager of Information Systems at the College
Mr. Jack Braun, Assoc. Professor of Electronic Technology (BCC)

APPENDIX CONTENTS

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Packet/Unit #8, "Computer Aideo Schematic Drawing	5
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DDT105, F84, Packet # 1 , Title Page, Instructor: Bryenton

Packet Title: Beam Selection

Course # : DDT105

Course Title : Structural Systems I

Course Content : Steel Construction

Packet Timing : 6 class/lab hours (one week exposure)

Institution : Burlington County College

Revision # : Original

Instructor : David C. Bryenton

Support Grant : N. J. Dept. of Education, Voc. #SCDG-430, FY84

Packet Content :

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Appendices

A. Computer Operation Schedule

B. Sample Program Print Out

C. Sample Program Diagrams

D. Homework Assignment

E. Student Evaluation Form

F. Homework Assignment Answers (not handed out to students)

DDT105, F85, Packet # 1 , Goals, Rationale, Objectives, Learning Activities
Instructor: Bryenton

Goals. The general goal of this packet is to familiarize the students with solving beam design problems on the computer, using "user friendly" software. The prerequisite topics for starting this packet are a thorough knowledge of beam design including the topics of loading configurations, support configurations, beam geometry, shear diagrams, bending moment diagrams, deflection, material properties, section properties, and supporting calculations for all of the above.

Rationale. The reasons for studying beam design on the computer are: 1. much more rapid solution of bear problems is possible; 2. iteration of cyclical problem solutions may be done rapidly; and 3. the use of computerized beam solutions is expanding rapidly in industry.

Objectives: 1. to familiarize students with using "user friendly" software to solve computer problems. (i.e. software that doesn't require prerequisite knowledge of a computer language like BASIC or FORTRAN;

2. to demonstrate to the student the solution of a medium complex beam problem on the computer.

3. to have the students solve a similar but different beam problem on the computer, using open lab exposure to computer facilities. The problem solution will take the form of: a. a computerized numerical solution plus; b. a series of diagrams, including loading, shear, bending moment, and deflection.

Learning Activities: 1. The student will watch a 1-2 hour demonstration by the instructor, solving a practice beam problem on a microcomputer[1], using user friendly software[2] to generate a numerical data solution.

Note: [1] Probably a DEC Rainbow 100 or an IBMPC.

[2] Disco Tech's BEAM-1 software program. (copyrighted material)

DDT105, F85, Packet # 1, Learning Activities (cont.), Assignment
Instructor: Bryenton

Learning Activities (cont.): 2. Student will solve a similar but different beam problem on the computer using given software[2] to generate the numerical solution.

3. Student will construct four graphs from the numerical data in item 2 (above) including: a. load; b. shear; c. bending moment; and d. deflection diagrams.

4. Student will compare the numerical and graphical analysis of: a. the computer generated beam; and b. the previously done hand calculations for the same beam from the same or previous course(s).

Assignment: Period 1, 2 hrs., meet in the computer lab, room ____, main campus, and with the Instructor demonstrate a beam design problem on the computer. Be prepared to take copious notes on the operation of the computer and the appropriate software.

See the attached computer operation schedule in the Appendix, Page A1. Follow the Instructor as s/he demonstrates the program operation, asking questions and making notes in the right hand (blank) columns when appropriate.

Period 2, 2 hrs., work through the practice program the Instructor demonstrated in lecture until your printout matches the sample numerical results given by the Instructor, Appendix, Page B1.

Start on the problem given in your packet on Page D1, Appendix, to produce a numerical solution. The steps for computer and software operation are the same as for the practice program.

Resources available include: a. software literature; b. hardware literature; c. this packet; d. your textbook (course content); e. lab supervisor; and f. your Instructor. The literature will be available in the computer laboratory.

Note: [2] Disco Tech's BEAM-1 software program.

DDT105, F85, Packet # 1 , Assignment (cont.), Evaluation, Bibliography
Instructor: Bryenton

Assignment (cont.): Period 3, 2 hrs., complete your assigned Beam analysis problem, obtaining numerical data from the computer, printed on 8½ x 11 sheets and constructing the following diagrams to suit the data: a. loading; b. shear; c. bending moment; and d. deflection.

Open lab time will be available, if needed, to complete the computer analysis. See the lab supervisor.

Evaluation: The student product of this packet will include: a. a print out of the computer analysis of the assigned problem; and b. the four diagrams mentioned above.

The student's answer will be evaluated by comparison with the instructor's answer. (The problems will be individual where possible).

The homework problem is the test on this packet. There will be no separate test on this packet except possibly some general questions on the final examination.

Bibliography:

1. Simplified Design of Structural Steel, by Parker and Ambrose, 5th ed., 1983.

2. Disco-Tech Software Instruction Manual, by Disco-Tech, a division of Morton Technologies, Inc., Santa Rosa, California, 1982.

3. "Beam-1" software program from source in Item 2, above.

4. Owner's Manual, User's Guide, and Starting-Out Manual for the DEC Rainbow 100 Computer, by the Digital Equipment Corporation, 1982.

5. Installing and Using the LA50 Printer, EK-OLA50, VG-001, by Digital Equipment Corporation, 1982, Maynard, Mass.

DDT 105, F85, Packet # 1 , Computer Operation Schedule, AP. A1

Instr.: Bryenton

Steps for Sample Program [2,3]	Sample Program Notes.
1. Press computer start button #1.	(2)
2. Wait for 1st "digital" menu to appear on CRT.	
3. Insert software disk into drive A. Press A on key-board. This laods CPM86/80 into CPU.	
4. When red light goes out on Drive A, remove CPM86/80 disk, and store back in envelope.	
5. Insert BEAM-1 disk into Drive A.	
6. Type (BEAM) on keyboard. This loads the program to CPU.	
7. Wait until "Option List" appears.	
8. Press "1" on keyboard.	
9. DATE: ="March 17, 1983", return.	
10. JOB NUMBER: ="82987", Return.	
11. Job Description: ℓ1"The Oaks" ℓ2, Santa Rosa, California.	
12. Press "RETURN" to option list.	

NOTE: (1) CRT = Cathode Ray Tube.
(2) These steps are exerpted from reference 2, pp.33-42.
(3) These specific steps are performed on the DEC 100 Rainbow microcomputer, CP/M 86, 128k.

Cont.

13. Type option "2,Return".

14. Beam Description = "Roof Beam No. 7", return.

15. Overal Beam Length = "47.5", return.

16. Distance to left support = "7.5", return.

17. Distance to right support = "45.5", return.

18. Choose option #3.

Input of Loads

19. Load Description = "Dead plus live load", return.

20. Un.load on left cantilever = "350", return.

20. Un.load on center span = "525", return.

20. Un.load on right cantilever = "285", return.

21. Point Load on left cantilever tip = "1200", return.

22. Point load on right cantilever tip= "800", return.

23. Input point loads = "1", return.

Questions & Notes

Cont. Input of point loads

Notes

24. Type "4", return.

25. Type as follows:

Load	Feet	Pounds
1	"4"	"750"
2	"12.50"	"1350"
3	"22.0"	"680"
4	"37.0"	"325"

With "return" after each entry.

26. Choose Option "4", return.

27. Compare all the calculated values to the printout in Appendix, page B1.

28. Press any key to return to menu.

29. Choose Option #5.

Point Load Analysis

30. Type "3", return.

31. Type "12.0", " ,
22.0 , " ,
37.2 , " ,

32. Check Moment and shear values in Appendix, page B2.

Note that multiple shear values appear at 22.0:

Cont.

33. Return to Menu.

34. Choose Option "6", return.

Material Properties of Beam

35. Elastic Modulus = "1.6", return.

36. Allowable Binding Stress = "2400", return.

37. Allowable Horizontal Shear = "165", return.

38. Allowable Overstress = "25", return.

39. Choose Option "7", return.

Calculate Req'd Section Properties

40. Desired width = "5.125", return.

Note that required min. depth is automatically given.

41. Desired Depth = "25.5", R (1)

42. Check tabular values against Appendix, page B2.

43. Compare the actual shear and bending stress with the max. allowable shear and bending stress.

Notes

Note: (1) R = Return

Cont.

Notes

44. R

45. Choose Option "9", R.

Calculate Deflections

46. Number of locations = "600", R. (Note change operation)

47. (Calculation pause may be several minutes.)

Design Calculation Results

48. Calculate Minimum Beam Based on Deflection Factor = "R"

49. Number of Analysis Points to be viewed = "5", R.

Calculate Deflections

50. Type in following Table

Point	Position	Deflection
1	"3.75" R	
2	"12.0" R	
3	"18.0" R	
4	"30.0" R	
5	"35.5" R	

Pause after each position input for deflection to be calculated.

51. Check Deflection Table in Appendix, Page B2 for comparisons.

52. Return to Menu.

53. Set up Printer as follows: (3)

a. Turn off Printer Power.

(reference 5., pp. 10-11)

Note: 3 Paraphrased form

Cont. Printer Operation, cont.

b. "Open paper window."

c. "Pull bail bar away from planten."

d. "Push paper release toward back of printer."

e. "Push paper through slot in paper cover and guide it to front of platen. Align paper." Center paper to red lines on bail bar.

f. "Pull paper release forward."

g. "Close paper window."

h. "Turn platen knob to reposition paper."

i. Turn on printer power.

Print Results (8 1/2 x 11)

54. Format to be used = "R".

55. When printer stops, extract page 1 and insert blank page 2 by steps above.

56. Press "Ready" on printer.

57. Repeat step #55.

58. Page 3 will be printed.

59. Turn off printer.

60. Choose Option #12.

61. Extract disk from drive A and store properly before power down.

62. Turn off computer by pressing "O" button on machine.

Appendix B1

* BEAM DESIGN AND ANALYSIS PROGRAM NO.1 *

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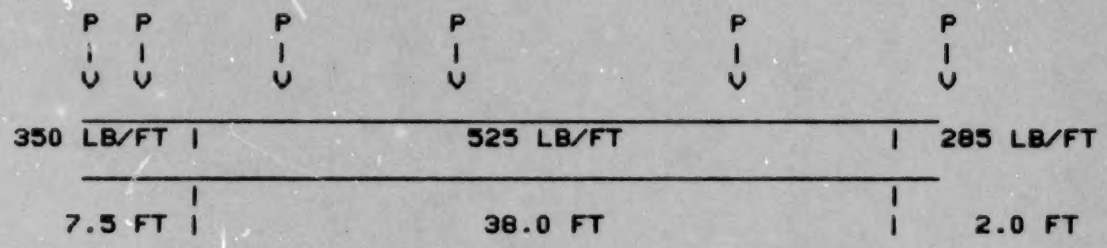
FOR USE BY

JOB NO. 82987 MARCH 17, 1983

THE OAKS
SANTA ROSA, CALIFORNIA

BEAM GEOMETRY



BEAM DESCRIPTION: ROOF BEAM NO. 7.
OVERALL BEAM LENGTH (FEET)..... 47.5
DISTANCE TO LEFT SUPPORT (FT).... 7.5
DISTANCE TO RIGHT SUPPORT (FT)... 45.5
(DISTANCE MEASURED FROM LEFT END)

LOADINGS

LOAD DESCRIPTION: DEAD PLUS LIVE LOAD
UNIFORM LOAD ON LEFT CANTILEVER (PLF)..... 350
UNIFORM LOAD ON CENTER SPAN (PLF)..... 525
UNIFORM LOAD ON RIGHT CANTILEVER (PLF)..... 285
POINT LOAD ON TIP OF LEFT CANTILEVER (LBS)... 1200
POINT LOAD ON TIP OF RIGHT CANTILEVER (LBS).. 800
POINT LOADS:

DISTANCE FROM LEFT END	LOAD IN POUNDS.
4.00	750.00
12.50	1,350.00
22.00	680.00
37.00	325.00

LOAD CALCULATIONS

REACTIONS:
LEFT SUPPORT = 16,723 POUNDS.
RIGHT SUPPORT = 11,527 POUNDS.

MAXIMUM MOMENTS AND SHEARS:

DESCRIPTION	MOMENT('#)	SHEAR(#)
LEFT SIDE OF LEFT SUPPORT	-21,469	-4,575
RIGHT SIDE OF LEFT SUPPORT	-21,469	12,148
LEFT SIDE OF RIGHT SUPPORT	-2,170	-10,157
RIGHT SIDE OF RIGHT SUPPORT	-2,170	1,370
CENTER SPAN AT 19.27 FEET FROM LEFT SUPPORT	-92,649	0

POINT LOAD ANALYSIS

POSITION FEET	MOMENT FT-LBS	SHEAR POUNDS
12.000	27,884	9,786
22.000	86,668	VARIES
37.200	64,046	-5,799

MATERIAL PROPERTIES

ELASTIC MODULUS (MEGA PSI)..... 1.6
ALLOWABLE BENDING STRESS (PSI)... 2400
ALLOWABLE HORIZ. SHEAR (PSI)..... 165
ALLOWABLE OVERSTRESS (%)..... 25
MAXIMUM ALLOWABLE STRESS (PSI)... 3000
MAXIMUM ALLOWABLE SHEAR (PSI).... 206.25

SECTION PROPERTIES

FOR A 5.125 X 25.5 :

BENDING STRESS (PSI)..... 2,177
SHEAR STRESS (PSI)..... 127

DEFLECTIONS

BASED ON NO. OF MATRIX POINTS USED IN THE
REAL MOMENT APPROXIMATIONS, THE ACCURACY OF
THE CENTER BEAM MAXIMUM DEFLECTION POSITION
IS PLUS OR MINUS 0.03 FEET.

MAXIMUM DEFLECTIONS:

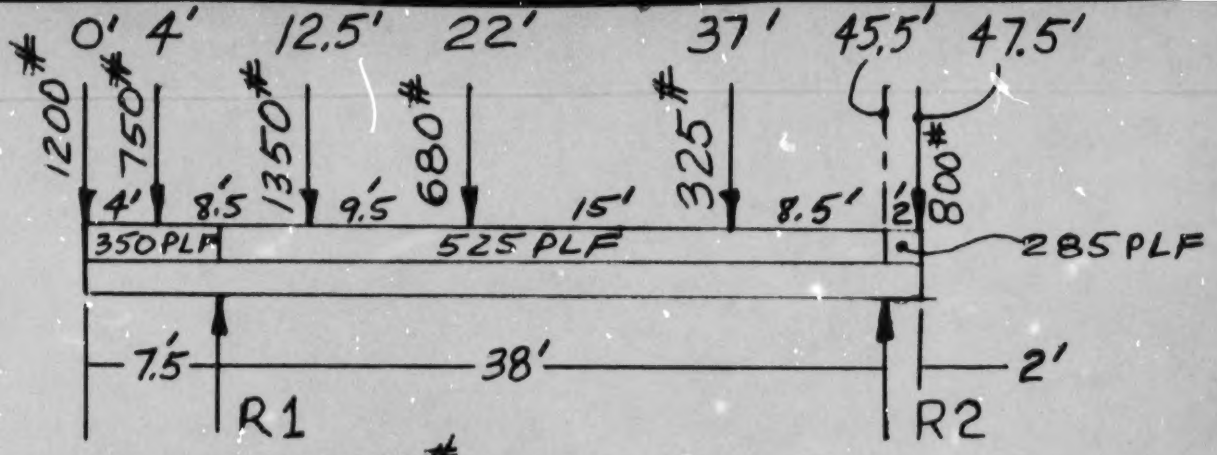
	DEFL. (INCHES)	POSIT. (FT)
TIP OF LEFT CANTILEVER	-1.16	0.00
CENTER SPAN	2.08	26.62
TIP OF RIGHT CANTILEVER	-0.35	47.50

DEFLECTION FACTOR = CENTER SPAN / MAXIMUM DEFLECTION= 218.78

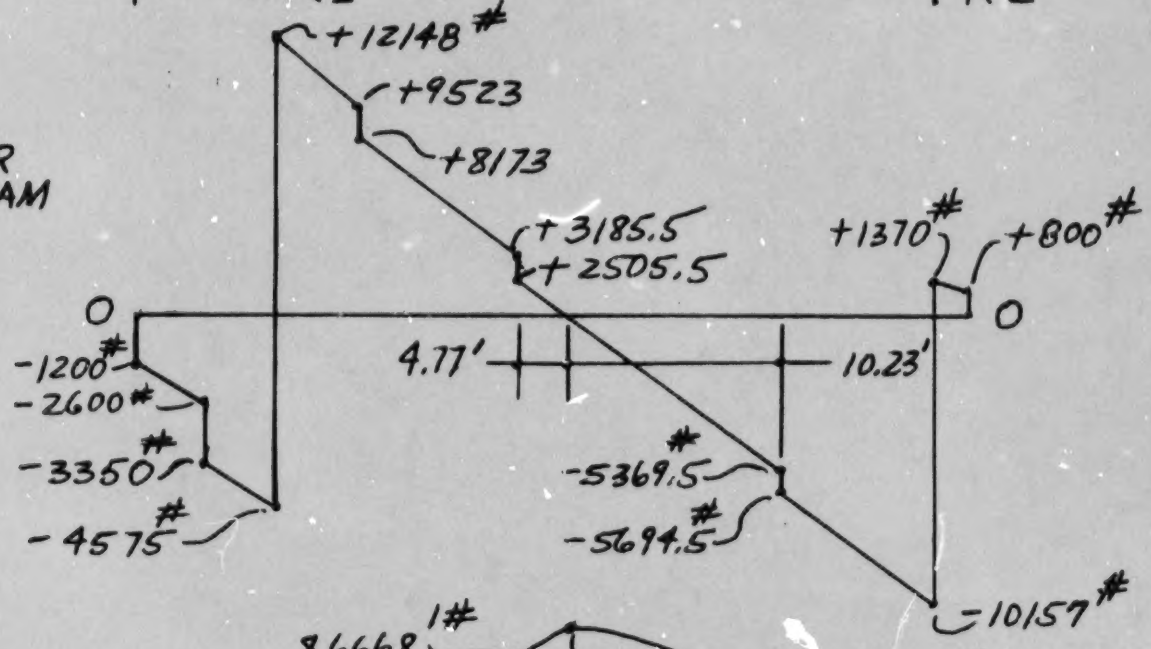
-0.59 INCHES AT 3.75 FEET
0.74 INCHES AT 12.00 FEET
1.57 INCHES AT 18.00 FEET
2.01 INCHES AT 30.00 FEET
1.56 INCHES AT 35.50 FEET

APPENDIX C1

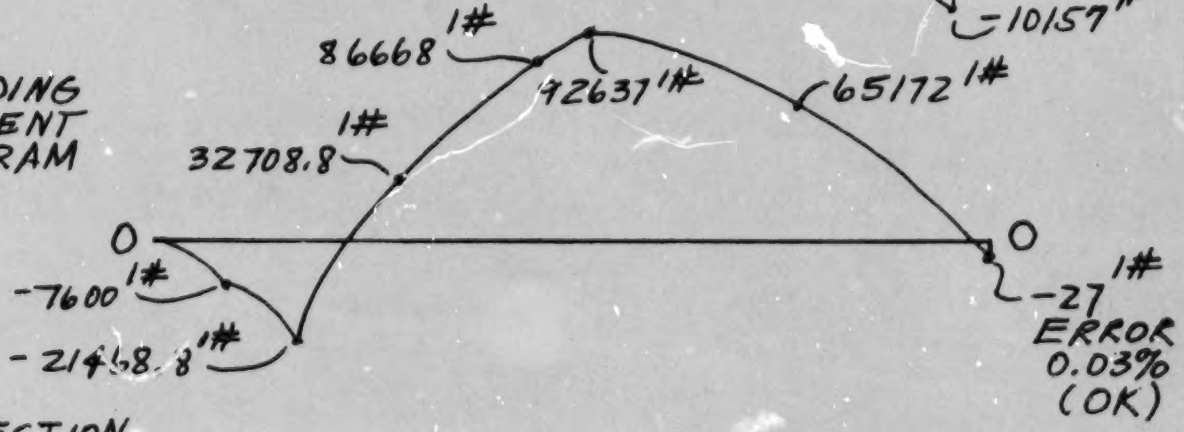
LOADING DIAGRAM



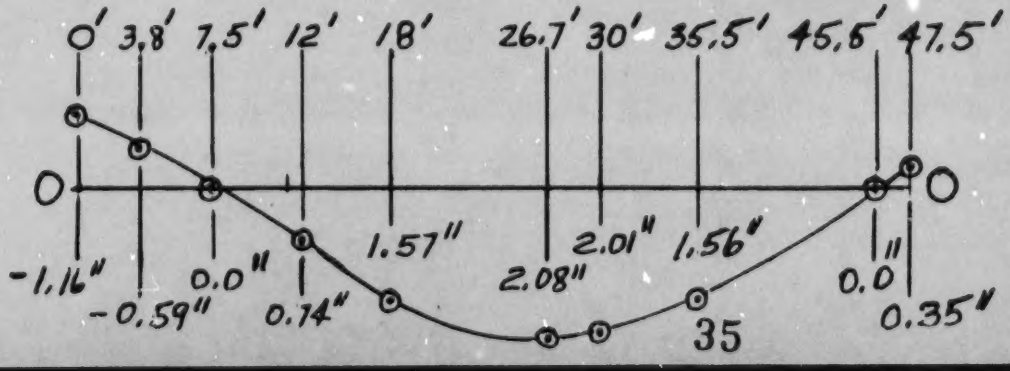
SHEAR DIAGRAM



BENDING MOMENT DIAGRAM

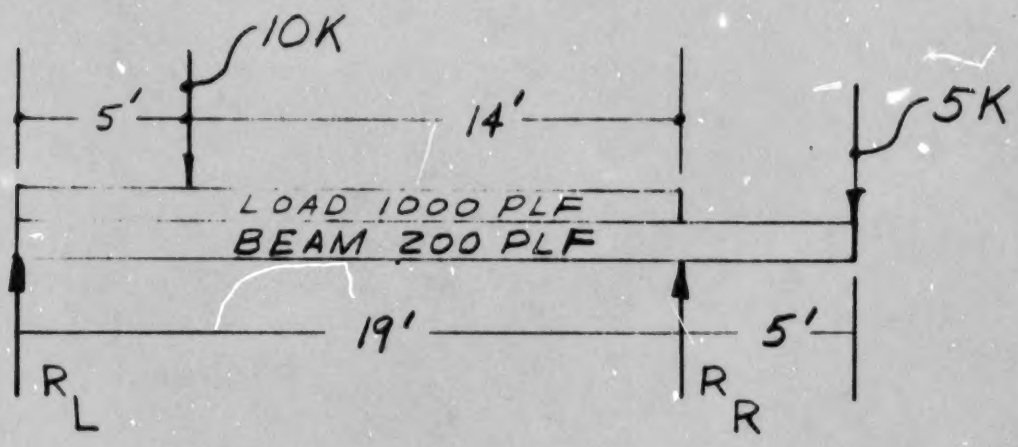


DEFLECTION DIAGRAM



DDT 105, F 85, Packet #1 Homework Assignment, App. D1

Problem: Design the most economical WF beam using the loading shown below on the Disco Tech Beam - 1 software program. Your product will include: a. computer numerical analysis and b. graphical diagrams, completely labelled like the sample beam on App. page C1.



Assume: a. A 36 steel

b. $E = 29(10)^6$ psi

c. $F^s = 24000$ psi

d. $F_v^b = 14500$ psi

e. allowable overstress = 0

f. 20 matrix points for deflection.

g. Deflection intervals 2.0'.

DATE: _____

COUSE: _____

PACKET #: _____

Student Evaluation Form
Appendix E1

A PACKET FEEDBACK SHEET

The objective of the following questionaire is to help the instructor respond to student needs and to improve his instruction. Your feedback would be most helpful. Do not sign your name. No grade is attached to this exercise.

1. Circle each of the words that tell how you feel (mostly) about the subject of this packet.

interesting	boring	worthless	dull	fun
too hard	exciting	useful	cool	square
useless	too easy	groovy	uptight	very important

2. What did you like most about this topic?

3. The instructions for this packet were: (circle one)

   a. very clear.
   b. somewhat clear.
   c. vague.
   d. no help.

4. What did you like least about this topic?

5. How would you improve the packet?

6. How interested are you in finding out more about the subject of this packet?

   a. very interested.
   b. somewhat interested
   c. don't care either way.
   d. not too interested.
   e. not at all interested.

7. Miscellaneous comments about this packet? In general.

Packet Feedback Sheet
Page Two

8. Comments about specific parts of this packet.

9. What do you like most about this packet format?

10. What do you like least about this packet format?

11. Comments, questions, and/or criticisms of this evaluation form?

* BEAM DESIGN AND ANALYSIS PROGRAM NO.1 *

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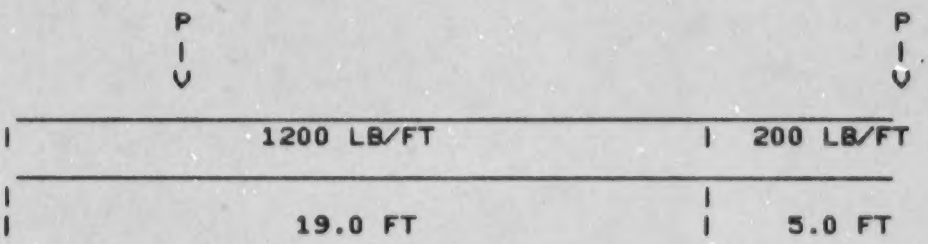
JOB NO. 1 March 23, 1984

Beam analysis for a complex beam, DDT105, Packet
#xx, Burlington County College, Ins: Bryenton

BEAM GEOMETRY



BEAM DESCRIPTION: Floor Beam No. 1
OVERALL BEAM LENGTH (FEET)..... 24
DISTANCE TO LEFT SUPPORT (FT).... 0
DISTANCE TO RIGHT SUPPORT (FT)... 19
(DISTANCE MEASURED FROM LEFT END)

LOADINGS

LOAD DESCRIPTION: Live load and dead load
UNIFORM LOAD ON CENTER SPAN (PLF)..... 1200
UNIFORM LOAD ON RIGHT CANTILEVER (PLF)..... 200
POINT LOAD ON TIP OF RIGHT CANTILEVER (LBS).. 5000
POINT LOADS:

DISTANCE FROM LEFT END	LOAD IN POUNDS.
5.00	10,000.00

LOAD CALCULATIONS

REACTIONS:
LEFT SUPPORT = 17,321 POUNDS.
RIGHT SUPPORT = 21,479 POUNDS.

MAXIMUM MOMENTS AND SHEARS:

DESCRIPTION	MOMENT('#)	SHEAR(#)
LEFT SIDE OF LEFT SUPPORT	0	0
RIGHT SIDE OF LEFT SUPPORT	0	17,321
LEFT SIDE OF RIGHT SUPPORT	-27,500	-15,479
RIGHT SIDE OF RIGHT SUPPORT	-27,500	6,000
CENTER SPAN AT 6.10 FEET FROM LEFT SUPPORT	-72,332	0

POINT LOAD ANALYSIS

POSITION FEET	MOMENT FT-LBS	SHEAR POUNDS
5.000	71,605	VARIES

MATERIAL PROPERTIES

ELASTIC MODULUS (MEGA PSI)..... 29
ALLOWABLE BENDING STRESS (PSI)... 24000
ALLOWABLE HORIZ. SHEAR (PSI)..... 14500
ALLOWABLE OVERSTRESS (%)..... 0
MAXIMUM ALLOWABLE STRESS (PSI)... 24000
MAXIMUM ALLOWABLE SHEAR (PSI).... 14500

SECTION PROPERTIES

SECTION MODULUS (IN^3)..... 38.4
AREA FOR SHEAR (IN^2)..... 7.68
MOMENT OF INERTIA (IN^4).... 301

BENDING STRESS (PSI)..... 22,604
SHEAR STRESS (PSI)..... 2,255

DEFLECTIONS

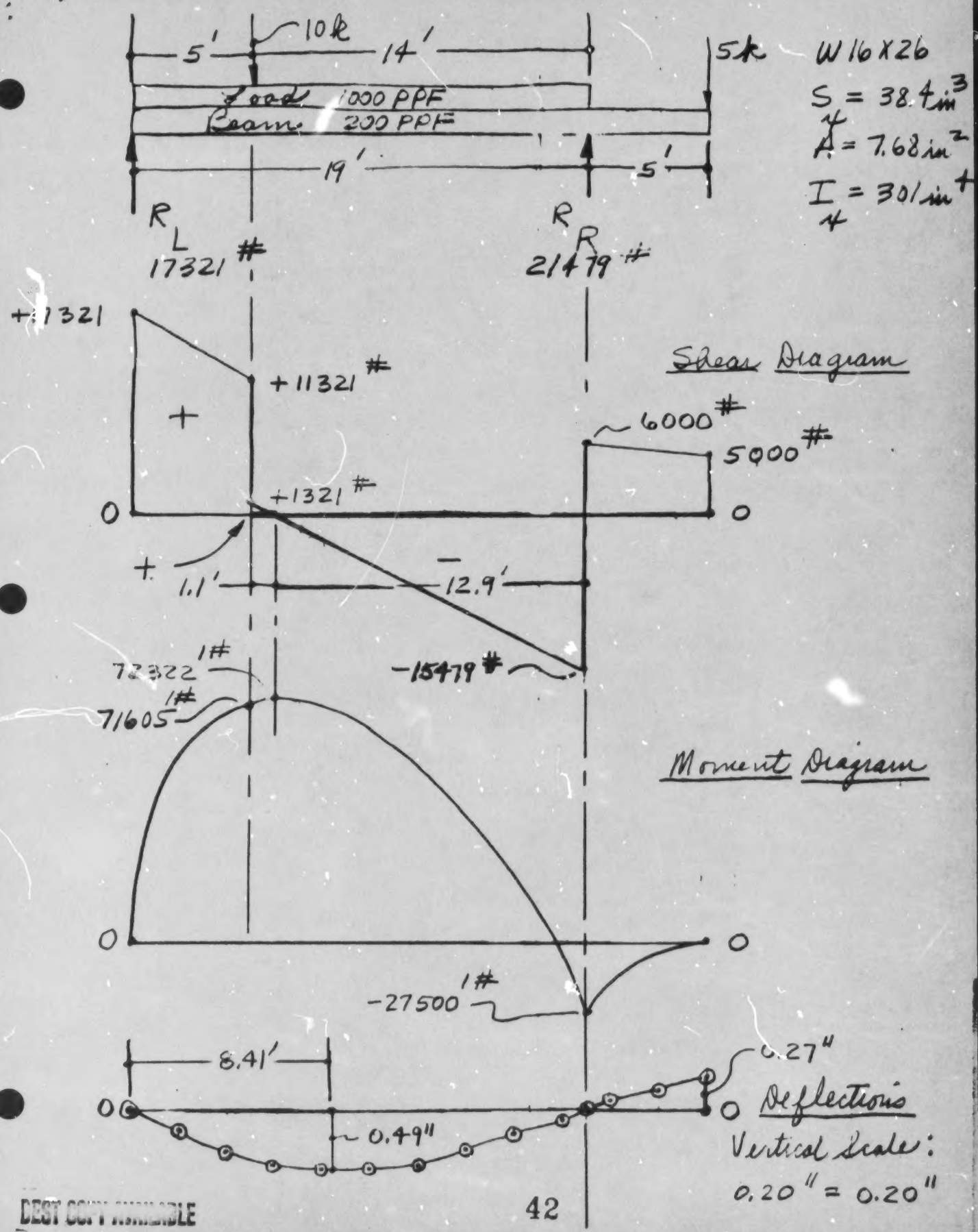
BASED ON NO. OF MATRIX POINTS USED IN THE
REAL MOMENT APPROXIMATIONS, THE ACCURACY OF
THE CENTER BEAM MAXIMUM DEFLECTION POSITION
IS PLUS OR MINUS 0.6 FEET.

MAXIMUM DEFLECTIONS:

	DEFL. (INCHES)	POSIT. (FT)
CENTER SPAN	0.49	8.41
TIP OF RIGHT CANTILEVER	-0.27	24.00

DEFLECTION FACTOR = CENTER SPAN / MAXIMUM DEFLECTION= 467.49

0.00	INCHES AT	0.00 FEET
0.18	INCHES AT	2.00 FEET
0.33	INCHES AT	4.00 FEET
0.44	INCHES AT	6.00 FEET
0.48	INCHES AT	8.00 FEET
0.48	INCHES AT	10.00 FEET
0.42	INCHES AT	12.00 FEET
0.32	INCHES AT	14.00 FEET
0.20	INCHES AT	16.00 FEET
0.06	INCHES AT	18.00 FEET
-0.06	INCHES AT	20.00 FEET
-0.17	INCHES AT	22.00 FEET
-0.27	INCHES AT	24.00 FEET



BEST COPY AVAILABLE

EGR 203, F84, Packet #2, Title Page, Instr: Bryenton, Pl

Packet Title:	Loop Traverse Calculations
Course Title:	Surveying
Course Content:	Introduction to Surveying
Packet Timing:	6 class/lab hours (one week exposure)
Institution:	Burlington County College
Revision # :	Original
Instructor:	David C. Bryenton
Support Grant:	N.J. Dept. of Education, Voc., #SCDG-430, FY84

Packet Content:

Title Page	Page	1
Goals		2
Rationale		2
Objectives		2
Learning Activities		2
Assignment (activities)		3
Evaluation		4
Bibliography		4

Appendices

A. Computer Operation Steps

B. Sample Program Printout

C. Sample Program Diagrams

D. Homework Assignment (written)

E. Homework Data (Graph not included)

F. Student Evaluation Form

EGR 203, F85, Packet # 2 , Goals, Rationale, Objectives, Learning Activities
Instructor: Bryenton

Goals: The general goal of this packet is to familiarize the students with solving loop traverse surveying problems on the computer, using "user friendly" software. The prerequisite topics for starting this packet are a thorough knowledge of Surveying topics including transit operation, running a field traverse, and converting raw field data into organized lab data and graphs.

Rationale: The reasons for studying Surveying on the computer are: 1. much more rapid solution of surveying problems is possible; 2. iteration of cyclical problem solutions may be done very rapidly; and 3. the use of computerized surveying solutions is expanding rapidly in industry.

Objectives: 1. to familiarize students with using "user friendly" software to solve computer problems. (i.e. software that doesn't require prerequisite knowledge of a computer language like BASIC or FORTRAN).

2. to demonstrate to the student the solution of a medium complex loop traverse on the computer.

3. to have the students solve a similar but different loop traverse problem on the computer, using open lab exposure to computer facilities. The problem solution will take the form of: a. a computerized numerical solution plus; b. a diagram of the final loop traverse including all final data.

Learning Activities: 1. The student will watch a 1-2 hour demonstration by the instructor, solving a practice loop traverse problem on a microcomputer[1], using "user friendly" software[2] to generate a numerical data solution.

Note: [1]Probably a DEC Rainbow 100 or IBMPC.

[2]Disco Tech's Finder software program. (copyrighted material)

EGR 203, F85, Packet # 2 , Learning Activities (cont.), Assignment
Instructor: Bryenton

Learning Activities (cont.): 2. Student will solve the same loop traverse problem on the computer using given software[2] to generate the correct numerical solution, which assures that both the software and hardware are working properly.

3. Student will solve a different but similar problem, using the same software[2] and generating: a. an original data table; b. a loop closure data table and c. a final table of balanced data using the compass rule.

4. Student will then construct a final graph, based on data in #3 above, showing and labeling: a. traverse legs; b. interior angles; c. leg lengths; d. North; and e. 5 station points. The graph should be labeled in one corner with a. course; b. name; c. data; and d. section.

Assignment: Period 1, 2 hrs., meet in the computer lab,room _____, main campus, and with the Instructor demonstrate a loop traverse problem on the computer. Be prepared to take copious notes on the operation of the computer and the appropriate software.

See the attached computer operation schedule in the Appendix, Page A1 . Follow the Instructor as s/he demonstrates the program operation, asking questions and making notes in the right hand (blank) columns when appropriate.

Period 2, 2 hrs., work through the practice program the Instructor demonstrated in lecture until your printouts match the sample numerical results given by the Instructor, Appendix, Page B1 .

Start on the problem given in your packet on Page D1 , Appendix, to produce a numerical solution. The steps for computer and software operation for the homework are the same as for the practice program. Open lab hours are available for extra time.

Resources available include: a. software literature; b. hardware literature; c. this packet; d. your textbook (course content); e. lab supervisor; and f. your Instructor. The literature will be available in the computer laboratory.

Note: [2]Disco Tech's "Finder" software program. (copyrighted material)

EGR 203, F85, Packet #____, Assignment (cont.), Evaluation, Bibliography
Instructor: Bryenton

Assignment (cont.): Period 3, 2 hrs., complete your assigned loop traverse problem, obtaining tabulated numerical data from the computer, printed on 8½ x 11 sheets and constructing the following diagram to suit the data: loop traverse on 8½ x 11 sheet including: a. North; b. traverse legs; c. leg lengths; d. interior angles; e. angles to North from beginning and final legs.

Open lab time will be available, if needed, to complete the computer analysis. See the lab supervisor. Add name, date, course, section at corner of graph.

Evaluation: The student product of this packet will include: a. a printout of the computer analysis of the assigned problem; and b. the diagram mentioned above.

The student's answer will be evaluated by comparison with the Instructor's answer. (The problems will be individual where possible).

The homework problem is the test on this packet. There will be no separate test on this packet except possibly some general questions on the final examination.

Bibliography:

1. Surveying Fundamentals, by Jack McCormac, Prentice-Hall Inc., Englewood Cliffs, N.J., 1983.

2. Disco-Tech Software Instruction Manual, by Disco-Tech, a division of Morton Technologies, Inc., Santa Rosa, California, 1982, for "Finder" program.

3. Finder software program from source in Item 2 above. (copyrighted material)

4. Owner's Manual, User's Guide, and Starting-Out Manual for the DEC Rainbow 100 Computer, by the Digital Equipment Corporation, 1982.

5. Installing and Using the LA50 Printer, EK-OLA50, VG-001, by Digital Equipment Corporation, 1982, Maynard, Mass.

EGR 203, F85, Packet #2, Computer Operation Steps, Appendix A1

Instr: Bryenton, Practice Problem [1] pp. 31-43

Problem Steps [2]

1. Turn on computer.
2. Insert CPM 86/80 working copy disk and load into central processing unit.
3. Remove CPM 86/80 disk and file.
4. Insert "Finder DM" (prepared) disk in drive A.
5. Insert Finder Data Disk in drive B.
6. Type "Finder DM" and press entry key.
7. Enter job number as supplied by instructor. (#2)
8. Enter "Yes" this is correct job file.
9. Original data from previous disk file? "No."
10. Change point proportionment? "Yes."
11. Change to 6 Traverse points and 4 Trav. Side Shots.
12. Temperature? "R" [3]
13. Scale factor? "R"
14. Slope Angle? "3" (horizontal) distances.
15. Type H. Angle? "1" (turned)
16. Accept above answers. "0"

(3) R = return key.

(2) For CPM86 version on a DEC 100 Rainbow microcomputer.

Note: (1) Disco-Tech, Survey 80, "Finder DM" Instructional Manual, CP/M, Field Note Data Reduction, copyright 1982.

Initial Transit Reference Data	See page 31 through 43 of Instruction Manual, Survey 80, Finder (TM)/CP/M (TM), Field Note Data Reduction, pp. 31-44.
17. From point # ? "1"	
18. Northing? "10000"	
19. Easting? "10000"	
20. Backsight bearing? "N000000E"	
21. Next point? "1" traverse point.	
22. To point # ? "2"	See Bib. ②, p. 31.
23. Backsight angle? "251.2200"	
24. Distance? "197.98"	
25. Next point? Side shot #7, "2".	See Bib. ②, p. 31.
Backsight angle? "52.1503"	
26. Distance "31.61"	
27. Next point? "2"	
28. Side shot "#8"	See Bib. ②, p. 31.
29. Backsight angle? "97.3519"	
30. Distance? "103.43"	
31. Next Point? "3"	See Bib. ②, p. 31.
32. Backsight angle: "180"	
33. Distance: "294.35"	
34. Next point? "1"	
35. Traverse Point? "4"	See Bib. ②, p. 31
36. Backsight angle? "89.3256"	(Error, but go on)
37. Distance? "380.56"	
38. Next point "1"	
39. Traverse Point? "5"	See Bib. ②, p. 31.
40. Backsight angle? "109.0536"	
41. Distance? "182.04"	
42. Next shot? "2"	

Problem Steps, cont.

43. Traverse Side Shot? "9"
44. Backsight angle? "93.43"
45. Distance? "254.54"
46. Next Shot? "2"
47. Traverse Side Shot? "10"
48. Backsight angle? "286.525"
49. Distance? "21.5"
50. Next Shot "1"
51. Traverse Point? "6"
52. Backsight angle? "107.1159"
53. Distance? "541.13"
54. "Enter"
55. "1" Close Traverse.
56. Close on point? "1"
57. Closing Angle? "162.48"
58. Bearing closed upon? "N900000E"
59. "Enter"
60. Angle error too great. Get a printout. "Enter"
61. Print original data. "13"
62. Noting point 4 as incorrect, choose "4", change some values.
63. Change # "4"
64. Backsight angle? "89.3236"
65. Distance? "380.56"
66. Change # ? "Enter"
67. Close Traverse "1"

See Bib. ②, p. 31.

See Bib. ②, p. 31.

See Bib. ②, p. 31.

Problem Steps, cont.

68. Close on point? "1"

69. Closing angle? "162.48"

70. Bearing closed upon? "N90000E"

71. "Enter"

72. Angle error is OK.

73. Distribute angle error evenly. "1"

74. Go to option list. Print data or results on printer "10"

75. Now balance the traverse. Option "2"

76. Use Compass rule "1"

77. Output to printer. "4" This is the final printout producing the coordinates of this traverse.

End of Sample Problem

APPENDIX B

Sample Program Printout (1)

FIELD DATA TRAVERSE

BURLINGTON COUNTY COLLEGE, COURSE: EGR203, INSTR:BRYENTON
DISCO-TECH SOFTWARE, SURVEY 80,
6/28/84."

TAPE STANDARD TEMP. = N/A SCALE FACTOR = N/A SLOPE ANGLE = HORIZONTAL

POINT OF ORIGIN: 1
NORTHING: 10000
EASTING: 10000
BACKSIGHT BEARING:N900000E
BACKSIGHT POINT
NORTHING: N/A
EASTING: N/A

TYPE OF SHOT	POINT NUMBER	BACKSIGHT ANGLE	TURNED OR DEFLECTED	SLOPE ANGLE	TEMP	DISTANCE
TRAV.	2	251 22 0	T	0 0 0	0	197.9800
T.S.	7	52 15 3	T	0 0 0	0	31.6100
T.S.	8	97 35 19	T	0 0 0	0	103.4300
TRAV.	3	180 0 0	T	0 0 0	0	294.3500
TRAV.	4	89 32 56	T	0 0 0	0	380.5600
TRAV.	5	109 5 36	T	0 0 0	0	182.0400
T.S.	9	93 43 0	T	0 0 0	0	254.5400
T.S.	10	286 52 50	T	0 0 0	0	21.5000
TRAV.	6	107 11 59	T	0 0 0	0	541.1300

Note: (1) This sample program and its solution are taken from Bibliography #2 listing on page 4 of this packet. The sample problem is solved by the copyrighted software program "Finder" owned by the Disco-tech Microcomputer Products, a Division of Morton Technologies, Inc., Santa Rosa, California.

(2) Note that points 101, 102, 103, and 501 have been changed to points 7, 8, 9, and 10 for the writer's convenience. These have been noted in parentheses on the Appendix C diagram.

APPENDIX B

SAMPLE PROGRAM PRINTOUT (1)

FIELD DATA TRAVERSE

BURLINGTON COUNTY COLLEGE, COURSE: EGR203, INSTR:BRYENTON
DISCO-TECH SOFTWARE, SURVEY 80,
6/28/84."

FROM	ANGLE	BEARING	DISTANCE	NORTHING	EASTING	TO
		N 90 0 0 W		10000.000	10000.000	1
1 T	251 21 58	N 18 38 2 W	197.980	10187.602	9936.742	2
2 T	52 15 3	S 33 37 1 W	31.610	10161.278	9919.241	7
2 T	97 35 19	S 78 57 17 W	103.430	10167.786	9835.228	8
2 T	179 59 58	N 18 38 4 W	294.350	10466.521	9842.689	3
3 T	89 32 34	S 70 54 31 W	380.560	10342.048	9483.061	4
4 T	109 5 34	S 0 0 5 W	182.040	10160.008	9483.056	5
5 T	93 43 0	S 86 16 55 E	254.540	10143.503	9737.061	9
5 T	286 52 50	N 73 7 5 W	21.500	10166.252	9462.483	10
5 T	107 11 57	S 72 47 58 E	541.130	9999.987	9999.985	6

CLOSED ON POINT # 1
CLOSING ANGLE: 162 47 58
CLOSURE ERROR: 0.0199
LAT. ERROR: -0.0128
DEP. ERROR: -0.0152
DIRECTION: S 49 56 2 W
PERIMETER: 1596.060
PRECISION: 80203

APPENDIX B

SAMPLE PROGRAM PRINTOUT (1)

FIELD DATA TRAVERSE

BURLINGTON COUNTY COLLEGE, COURSE: EGR203, INSTR:BRYENTON
DISCO-TECH SOFTWARE, SURVEY 80,
6/28/84."

COMPASS RULE

FROM		ANGLE	BEARING	DISTANCE	NORTHING	EASTING	TO
1	T	251 21 58	N 18 37 59 W	197.981	10187.603	9936.744	2
2	T	179 59 58	N 18 38 1 W	294.351	10466.525	9842.693	3
3	T	89 32 34	S 70 54 31 W	380.556	10342.055	9483.069	4
4	T	109 5 34	S 0 0 3 W	182.039	10160.017	9483.066	5
5	T	107 11 57	S 72 48 0 E	541.134	10000.000	10000.000	6

APPENDIX B

SAMPLE PROGRAM PRINTOUT (1)

FIELD DATA TRAVERSE

BURLINGTON COUNTY COLLEGE, COURSE: EGR203, INSTR:BRYENTON
DISCO-TECH SOFTWARE, SURVEY 80,
6/28/84."

COMPASS RULE

FROM	ANGLE	BEARING	DISTANCE	NORTHING	EASTING	TO
		N 90 0 0 W		10000.000	10000.000	1
1 T	251 21 58	N 18 38 2 W	197.980	10187.603	9936.744	2
2 T	52 15 3	S 33 37 1 W	31.610	10161.278	9919.241	7
2 T	97 35 19	S 78 57 17 W	103.430	10167.786	9835.228	8
2 T	179 59 58	N 18 38 4 W	294.350	10466.525	9842.693	3
3 T	89 32 34	S 70 54 31 W	380.560	10342.055	9483.069	4
4 T	109 5 34	S 0 0 5 W	182.040	10160.017	9483.066	5
5 T	93 43 0	S 86 16 55 E	254.540	10143.503	9737.061	9
5 T	286 52 50	N 73 7 5 W	21.500	10166.252	9462.483	10
5 T	107 11 57	S 72 47 58 E	541.130	10000.000	10000.000	6

CLOSED ON POINT # 1
CLOSING ANGLE: 162 47 58
CLOSURE ERROR: 0.0199
LAT. ERROR: -0.0128
DEP. ERROR: -0.0152
DIRECTION: S 49 56 2 W
PERIMETER: 1596.060
PRECISION: 80203

The following pages contain examples of how we computed the traverse which is illustrated on this page.

NORTON TECHNOLOGIES (DISCO-TECH) (2)
400 B ST., SANTA ROSA, CA.

FIELD DATA TRAVERSE

SAMPLE SURVEY
400 B STREET
SANTA ROSA, CALIFORNIA

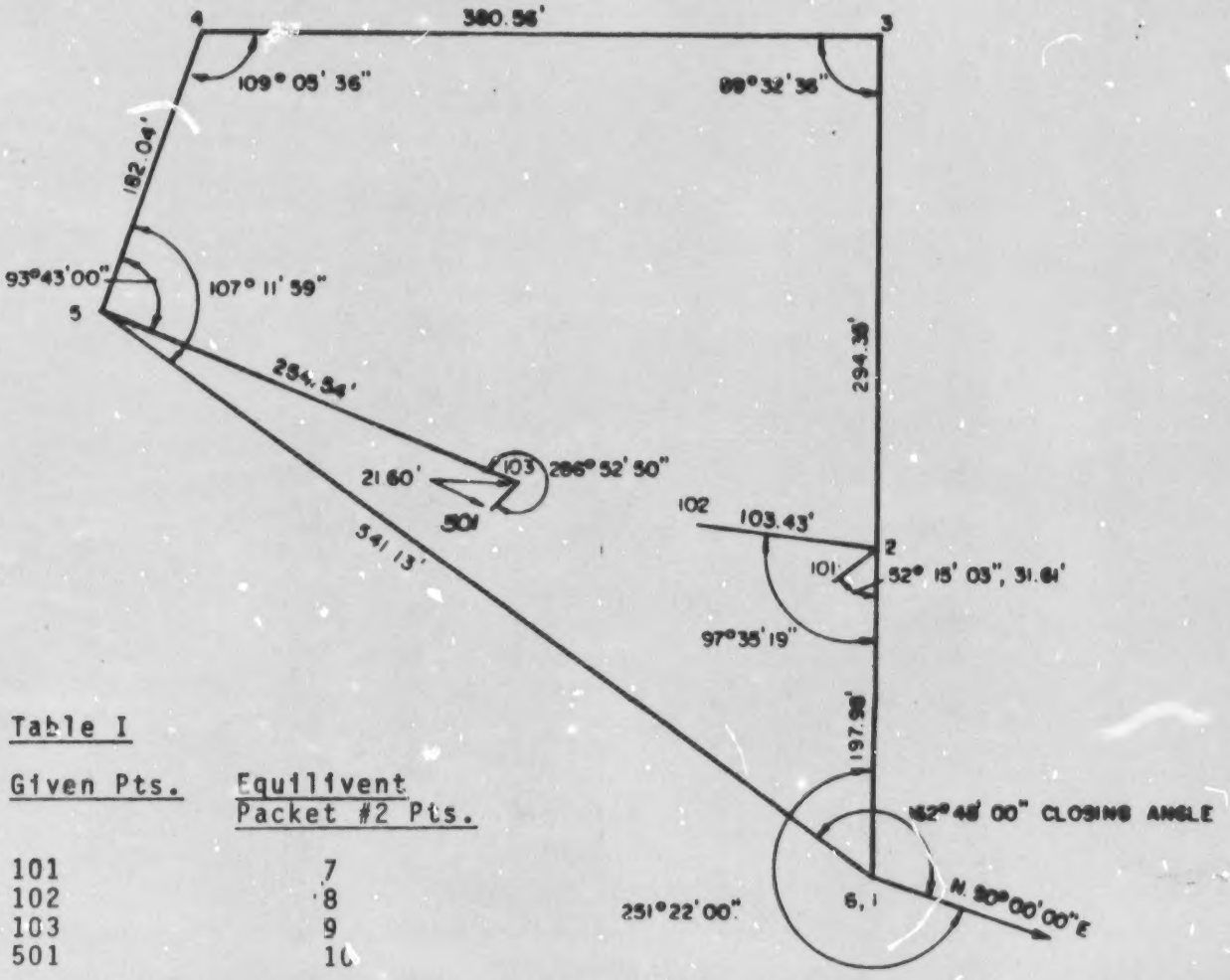


Table I

Given Pts.	Equilivent Packet #2 Pts.
101	7
102	8
103	9
501	10

Note:(1) For Packet #2, some point numbers have been changed for convenience , as shown in the Table I above.
(2) This page exerpted from Bib. (2), pp. 31.

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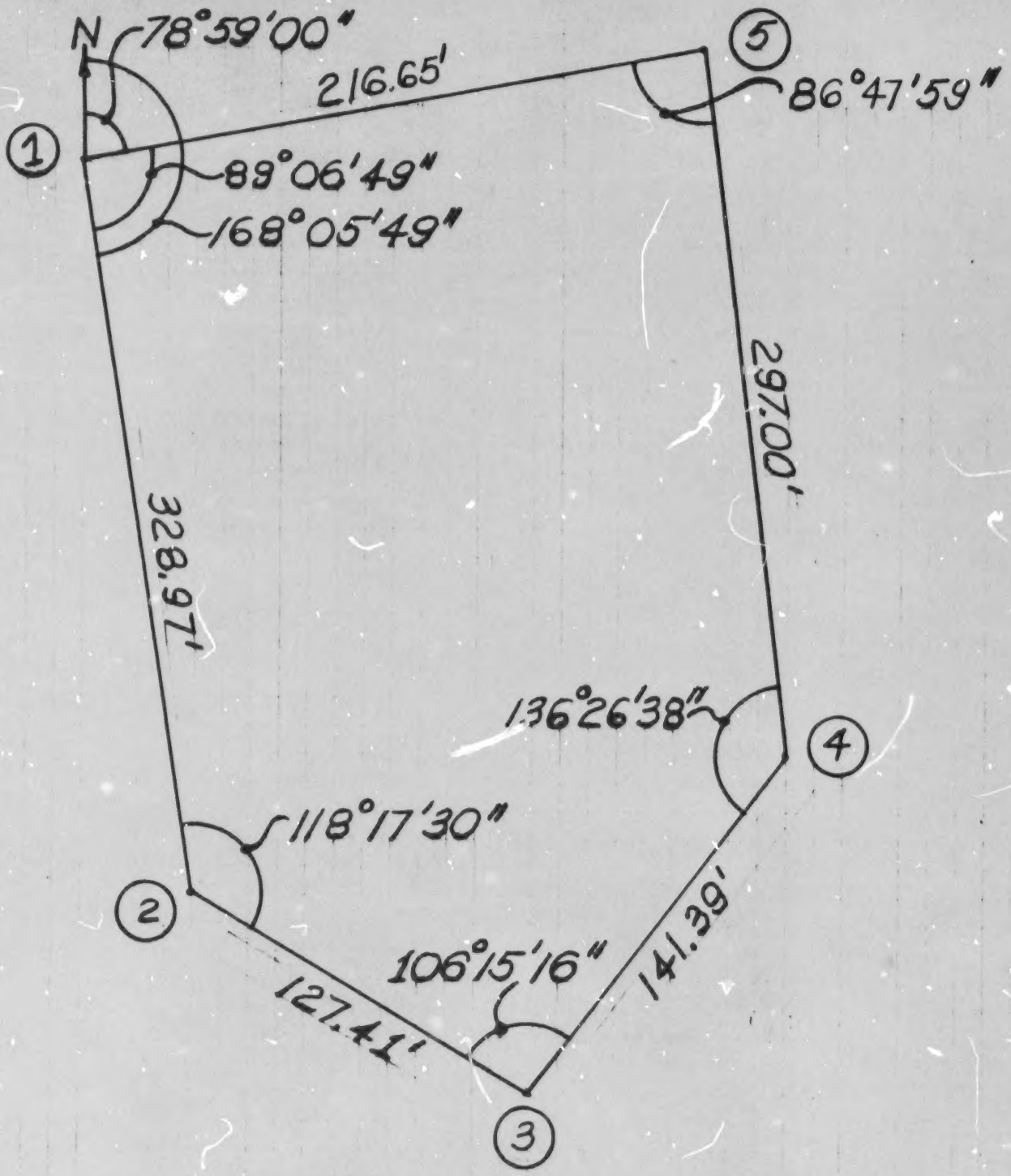
EGR203, f85, Packet #2, Homework Assignment, Appendix D1.

Problem: From the Field Data Traverse shown below, using the "Finder" software from Survey 80 Series, (see Bib. reference #2) close and balance the given loop traverse using the Compass Rule to develop northings and eastings for each of the traverse points.

Using this corrected data, draw a to-scale diagram of the final loop traverse on 24 x 36" paper, including overall grid, grid calibration, labeled interior angles, labeled leg bearings, labeled leg distances, labeled traverse station points, labeled beginning and final angles of beginning and final legs in relationship to North.

The graph legend will include your name, date, course, and section. See following page, App. D2.

EGR203, F85, Packet #2, Homework Assignment, Appendix D2, Loop Traverse Field Data.



APPENDIX E3

Student Homework Answers

FIELD DATA TRAVERSE

BURLINGTON COUNTY COLLEGE, COURSE: EGR203, INSTR:BRYENTON
DISCO-TECH SOFTWARE, SURVEY 80,
6/28/84."

COMPASS RULE

FROM	ANGLE	BEARING	DISTANCE	NORTHING	EASTING	TO
1 T	168 5 47	S 11 54 11 E	328.972	134.902	167.853	2
2 T	118 17 28	S 73 36 43 E	127.409	98.954	290.086	3
3 T	106 15 14	N 32 38 30 E	141.389	218.013	366.349	4
4 T	136 26 36	N 10 54 55 W	296.999	509.638	310.110	5
5 T	86 47 57	S 75 53 3 W	216.652	456.800	100.000	6

APPENDIX E1

Student Homework Answers

FIELD DATA TRAVERSE

BURLINGTON COUNTY COLLEGE, COURSE: EGR203, INSTR:BRYENTON
DISCO-TECH SOFTWARE, SURVEY 80,
6/28/84."

TAPE STANDARD TEMP. = N/A SCALE FACTOR = N/A SLOPE ANGLE = HORIZONTAL

POINT OF ORIGIN: 1
NORTHING: 456.8
EASTING: 100
BACKSIGHT BEARING:N000000E
BACKSIGHT POINT
NORTHING: N/A
EASTING: N/A

TYPE OF SHOT	POINT NUMBER	BACKSIGHT ANGLE	TURNED OR DEFLECTED	SLOPE ANGLE	TEMP	DISTANCE
TRAV.	2	168 5 49	T	0 0 0	0	328.9700
TRAV.	3	118 17 30	T	0 0 0	0	127.4100
TRAV.	4	106 15 16	T	0 0 0	0	141.3900
TRAV.	5	136 26 38	T	0 0 0	0	297.0000
TRAV.	6	86 47 59	T	0 0 0	0	216.6500

APPENDIX E2

Student Homework Answers

FIELD DATA TRAVERSE

BURLINGTON COUNTY COLLEGE, COURSE: EGR203, INSTR:BRYENTON
DISCO-TECH SOFTWARE, SURVEY 80,
6/28/84."

FROM	ANGLE	BEARING	DISTANCE	NORTHING	EASTING	TO
		S 0 0 0 E		456.800	100.000	1
1 T	168 5 47	S 11 54 13 E	328.970	134.904	167.855	2
2 T	118 17 28	S 73 36 44 E	127.410	98.957	290.089	3
3 T	106 15 14	N 32 38 30 E	141.390	218.016	366.352	4
4 T	136 26 36	N 10 54 54 W	297.000	509.643	310.115	5
5 T	86 47 57	S 75 53 4 W	216.650	456.807	100.007	6

CLOSED ON POINT # 1
CLOSING ANGLE: 75 53 4
CLOSURE ERROR: 0.0093
LAT. ERROR: 0.0067
DEP. ERROR: 0.0065
DIRECTION: N 44 19 22 E
PERIMETER: 1111.420
PRECISION: 119286

F84, Packet #3, Title Page, Instructor: Bryenton

Packet Title	:	Foundation Footings
Course #	:	DDT 106
Course Title	:	Structural Systems I
Course Content	:	Concrete Construction
Packet Timing	:	6 class/lab hours (one week exposure)
Institution	:	Burlington County College
Revision #	:	Original
Instructor	:	David C. Bryenton
Support Grant	:	N.J. Dept. of Education, Voc. #SCDG-430, FY84

Packet Content :

Title Page	Page 1
Goals	2
Rationale	2
Objectives	2
Learning Activities	2-3
Assignment	3
Evaluation	4
Bibliography	4

Appendices

A. Computer Operation Schedule

B. Sample Program Print Out

C. Sample Program Diagrams

D. Homework Assignment

E. Homework Assignment Answers (not handed out to students)

F. Student Evaluation Form

DDT 106, F85, Packet # 3 , Goals, Rationale, Objectives, Learning Activities
Instructor: Bryenton

Goals. The general goal of this packet is to familiarize the students with solving footing design problems on the computer, using "user friendly" software. The prerequisite topics for starting this packet are a thorough knowledge of footing design including the topics of ultimate strength design, shear and diagonal tension, column design, axial loading and bending and supporting calculations for all of the above.

Rationale. The reasons for studying footing design on the computer are: 1. much more rapid solution of problems is possible; 2. iteration of cyclical problem solutions with variable changes may be done rapidly; and 3. the use of computerized beam solutions is expanding rapidly in industry.

Objectives: 1. to familiarize students with using "user friendly" software to solve computer problems. (i.e. software that doesn't require prerequisite knowledge of a computer language like BASIC or FORTRAN)

2. to demonstrate to the student the solution of a medium complex footing problem on the computer.

3. to have the students solve a similar but different footing problem on the computer, using class and open lab exposure to computer facilities. The problem solution will take the form of: a. a computerized numerical solution plus; b. a series of diagrams, including wall/footing cross section, a concrete/earth pressure diagram, a shear diagram for wall and footing.

Learning Activities: 1. The student will watch a 1-2 hour demonstration by the instructor, solving a practice footing problem on a microcomputer[1], using user friendly software[2] to generate a numerical data solution.

Note: [1]Probably a DEC Rainbow 100.

[2]Disco Tech's Footing software program (copyright 1982).

DDT 106, F85, Packet # 3 , Learning Activities (cont.), Assignment
Instructor: Bryenton

Learning Activities (cont.): 2. Student will solve a similar but different footing problem on the computer using given software[2] to generate the numerical solution.

3. Student will construct four graphs from the numerical data in item 2 (above) including: a. footing/wall given dimensioning, b. earth/concrete pressure column, c. footing - wall end view and shear diagram, all properly labeled and dimensioned.

4. Student will compare the numerical and graphical analysis of: a. the computer generated footing; and b. the previously done hand calculations for the same footing from the same course.

Assignment: Period 1, 2 hrs., meet in the computer lab, room _____, main campus, and watch the Instructor demonstrate a footing design problem on the computer. Be prepared to take copious notes on the operation of the computer and the appropriate software.

See the attached computer operation schedule in the Appendix, Page A1. Follow the Instructor as s/he demonstrates the program operation, asking questions and making notes in the right hand (blank) columns when appropriate.

Period 2, 2 hrs., work through the same practice program the Instructor demonstrated in lecture until your print out matches the sample numerical results given by the Instructor, Appendix, Page B1.

Start on the problem given in your packet on Page D1, Appendix, to produce a numerical solution. The steps for computer and software operation are the same as for the practice program in Appendix A.

Resources available include: a. software literature; b. hardware literature; c. this packet; d. your textbook (course content); e. lab supervisor; and f. your Instructor. The literature will be available in the computer laboratory.

Note : [2]Disco Tech's Footing software program, (copyright 1982).

DDT 106, F85, Packet # 3 , Assignment (cont.), Evaluation, Bibliography
Instructor: Bryenton

Assignment (cont.): Period 3, 2 hrs., complete your assigned Footing analysis problem, obtaining numerical data from the computer, printed on 8½ x 11 sheets and constructing the following diagrams to suit the data: a. isometric wall/footing, b. earth/concrete pressure column, c. wall/footing end view and shear diagram.

Open lab time will be available, if needed, to complete the computer analysis. See the lab supervisor.

Evaluation: The student product of this packet will include: a. a print out of the computer analysis of the assigned problem; and b. the three diagrams mentioned above.

The student's answer will be evaluated by comparison with the Instructor's answer. (The problems will be individually different where possible).

The homework problem is the test on this packet. There will be no separate test on this packet except possibly some general questions on the final examination.

Bibliography:

1. Design of Reinforced Concrete, by Jack McCormac, Harper & Row, Inc., 1978.

2. Disco-Tech Software Instruction Manual, by Disco-Tech, a division of Morton Technologies, Inc., Santa Rosa, California, 1982.

3. "Footing" software program from source in Item 2, above.

4. Owner's Manual, User's Guide, and Starting-Out Manual for the DEC Rainbow 100 Computer, by the Digital Equipment Corporation, 1982.

5. Installing and Using the LA50 Printer, EK-OLA50, VG-001, by Digital Equipment Corporation, 1982, Maynard, Mass.

DDT 106, F85, Packet # 3 , Computer Operation Steps, Appendix A1

Footing Computer Operating Steps

1. Charge computer with CP/M86 operating system provided.
2. Remove and store disk.
3. Insert "Footing" disk provided with computer, drive A.
4. Insert "Footing Data Disk" into computer drive B.
5. Type "Footing".
6. Enter "(date", following cursor.
7. Enter Job Number "2".
8. Enter "1" for a continuous footing supporting a concrete wall or stem.
9. Enter no change, "0"
10. Work down page 23, on Example #1 from Footing Handbook, Bib. (2) Copy numbers opposite quantity titles.
11. Type "0" when enteries are correct.

(1) Continuous Footing with a concrete wall.

---

(1) These steps are for the Disco-Tech Footing Program (1982)
and the sample problem "Footing Example #1" from Bib. (2), pp.iii-23, CP/M86, Rainbow DEC 100 microcomputer.

12. Enter your desired design width at "2.500'"

13. Enter "0" to change no enteries.

NOTE: Note how reinforcing steel deminished the depth of footing.

14. Use no steel in design. "0"

15. List the design factors and results on the line printer, "3". (Note: Make line printer ready first.)

NOTE: The rapidity with which a continuous footing can be designed when all the design factors are available.

APPENDIX B1

Sample Program Printout

BURLINGTON COUNTY COLLEGE, DIVISION OF MATH, SCIENCE AND TECHNOLOGY, PEMBERTON-BROWNS-MILLS RD., PEMBERTON, N.J. 08068

FOOTING-1
ISOLATED AND CONTINUOUS FOOTING DESIGN PROGRAM
COPYRIGHT 1980 BY DISCO-TECH, SANTA ROSA, CA.

DATE: 7/22/84
JOB NUMBER: 2

> DESIGN TYPE:

* CONTINUOUS FOOTING WITH A CONCRETE WALL OR STEM *

ALLOWABLE BEARING ON SOIL IN PSF.....	2,000
DESIGN STRENGTH OF CONCRETE IN PSI.....	3,000
DESIGN STRENGTH OF STEEL IN PSI.....	40,000
DEAD LOAD IN PLF.....	3,000
LIVE LOAD IN PLF.....	2,000
WIDTH OF WALL IN INCHES.....	16.00

DESIGN FACTORS:

MINIMUM WIDTH OF FOOTING IN FEET... 2.5
USER ENTERED WIDTH IN FEET..... 2.5

** NO STEEL REINFORCEMENT BAR NEEDED FOR THIS DESIGN **

> FINAL DESIGN RESULTS:

WIDTH OF THE FOOTING IN FEET.....	2.50
THICKNESS OF FOOTING IN INCHES.....	4.18

***************** END OF CALCULATIONS *****************

APPENDIX C1, Sample Program for a Continuous footing with a Concrete Wall.(1)

Assumptions (2)

1. Continuous footing with a concrete wall.
2. Allowable bearing on soil. 2000 psf.
3. Design Strength of concrete. 3000 psi
4. Design strength of Steel. 40000 psi
5. Dead load. 3000 plf.
6. Live Load. 2000 plf.
7. Width of wall. 16.00".

Design factors entered(2)

User width of footing. _____

Design Criteria Developed(2)

Minimum width of footing. _____ _____.

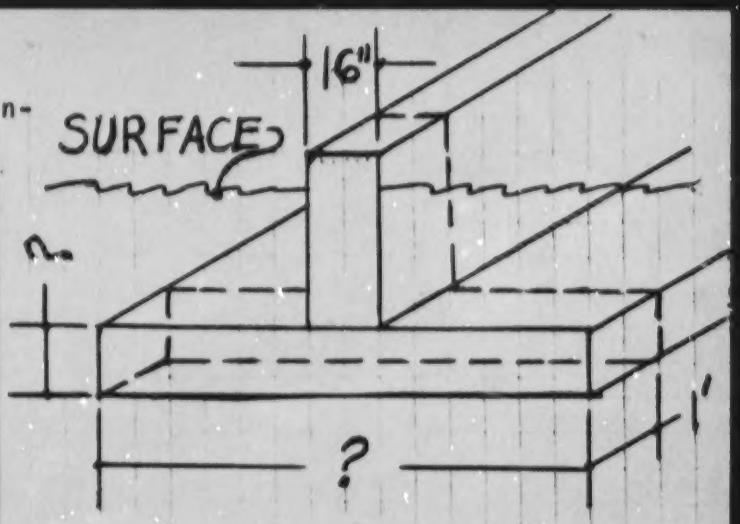
Final Design Decisions(2)

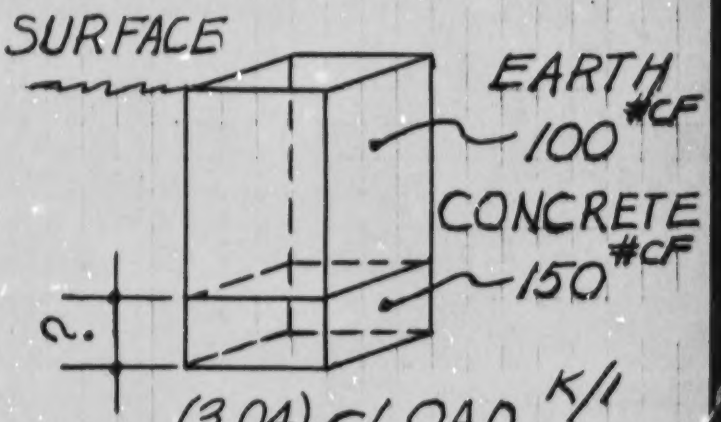
Width of footing. _____

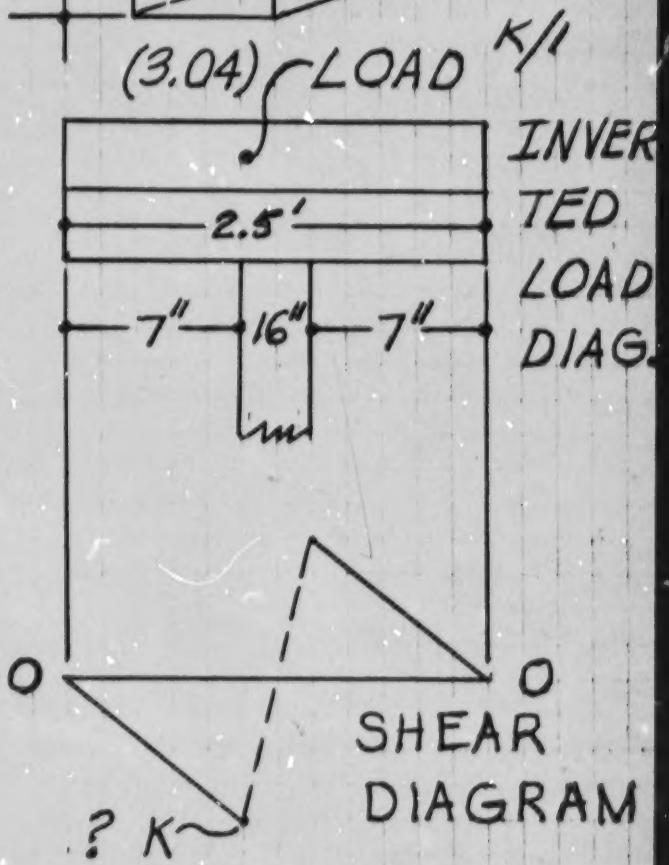
Thickness of footing. _____.

(1) "Footing Example No. 1, taken from Bib. (2), "Footing" Software Instructional Manual, pp. 22-23.

(2) Answers follow on App. C2.







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APPENDIX D1, Homework Assignment, A Continuous Footing with a Concrete Wall.

Assumptions (1)

1. Continuous footing with a concrete wall.

2. Allowable bearing strength of soil: 4000 psf.

3. Design strength of concrete: 4000 psi.

4. Design Strength of steel: 40000 psi.

5. Dead Load in plf: 20000.

6. Live load in plf: 15000.

7. Width of wall in inches: 12.00

Design Factors Entered

1. Minimum width of footing allowed: _____.

2. Width of footing used:_____. (design)

3. Minimum depth of reinforcement steel: _____.

4. Depth of reinforcement steel used:_____.(design)

Final Results

1. Footing width in ft:_____

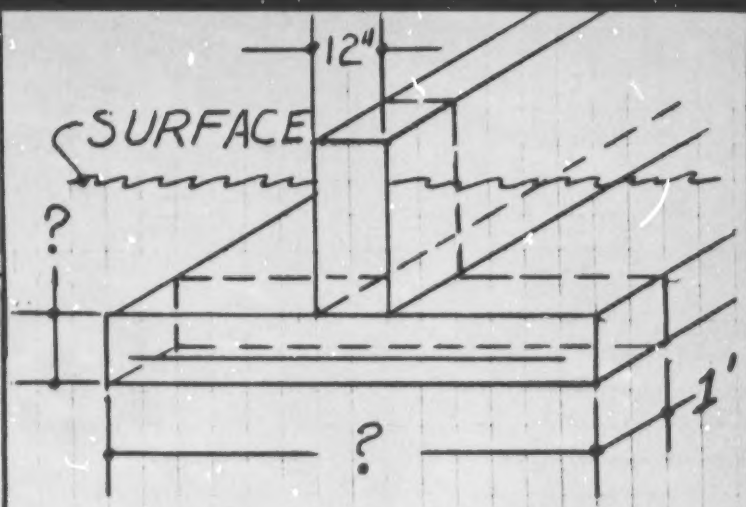
2. Required area of steel in sq. in./ ft:_____.

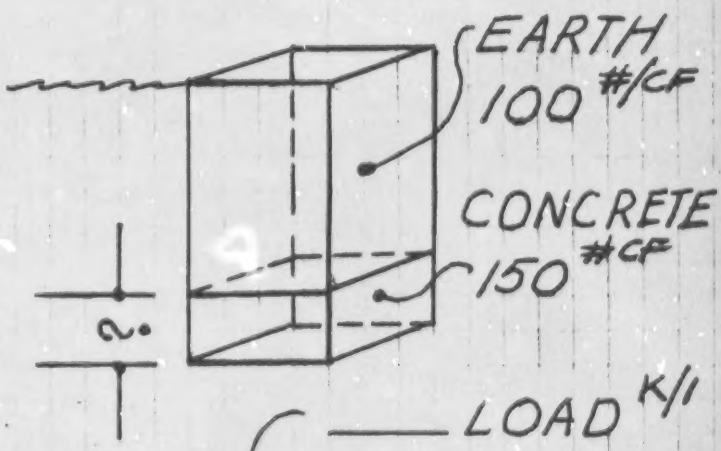
3. Required depth of steel in inches:_____.

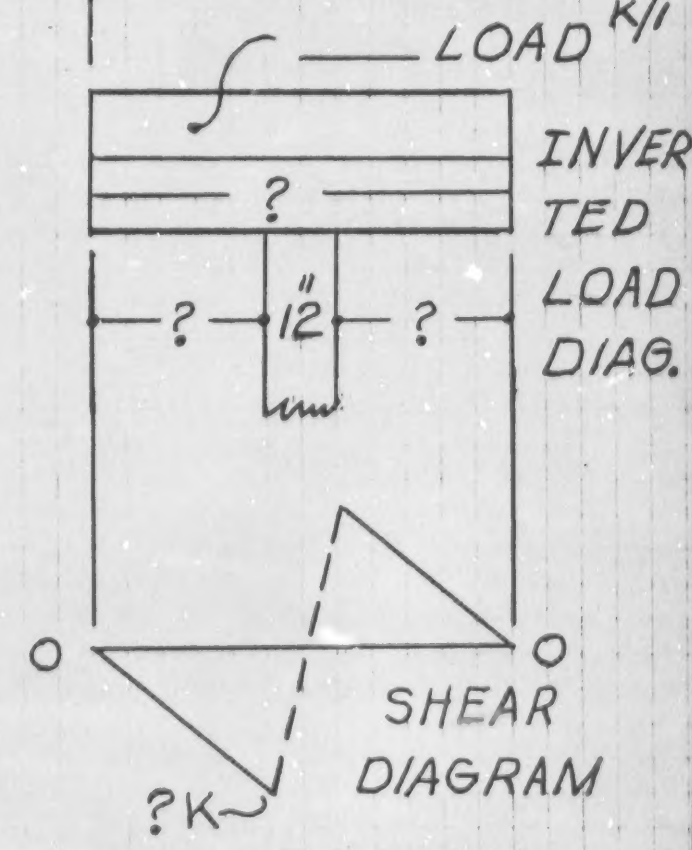
4. Max shear at wall:_____#

Note: (1) Answers follow in page G2.

5. Factored bearing pressure on footing in k/ft. _____.







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APPENDIX E1

Student Homework Answers

BURLINGTON COUNTY COLLEGE, DIVISION OF MATH, SCIENCE AND TECHNOLOGY, PEMBERTON-BROWNS-MILLS RD., PEMBERTON, N.J. 08068

FOOTING-1
ISOLATED AND CONTINUOUS FOOTING DESIGN PROGRAM
COPYRIGHT 1980 BY DISCO-TECH, SANTA ROSA, CA.

DATE: 7/22/84
JOB NUMBER: 3

> DESIGN TYPE:

★ CONTINUOUS FOOTING WITH A CONCRETE WALL OR STEM ★

ALLOWABLE BEARING ON SOIL IN PSF.....	4,000
DESIGN STRENGTH OF CONCRETE IN PSI.....	4,000
DESIGN STRENGTH OF STEEL IN PSI.....	40,000
DEAD LOAD IN PLF.....	20,000
LIVE LOAD IN PLF.....	15,000
WIDTH OF WALL IN INCHES.....	12.00

> DESIGN FACTORS:

MINIMUM WIDTH OF FOOTING IN FEET... 8.75
USER ENTERED WIDTH IN FEET..... 10

MINIMUM DEPTH FOR STEEL REINFORCEMENT BAR IN INCHES.. 13.83
USER ENTERED DEPTH IN INCHES..... 14.50

> FINAL DESIGN RESULTS:

WIDTH OF THE FOOTING IN FEET.....	10.00
AREA OF STEEL REQUIRED IN SQUARE INCHES/FT...	1.303 (1)
DEPTH OF STEEL IN INCHES.....	14.50

********** END OF CALCULATIONS **********

Note: (1) Compare this answer with the one porduced by the long-hand solution done earlier in the course. Notice the close correspondence.

(2) Max shear at the wall is 24.1k for an 18" footing and a d = 14.5".

(3) Factored bearing pressure on the footing is 5.35 k/ft. for the assumptions in (2) above.

Appendix F1

DATE: _____

COUSE: _____

PACKET #: _____

A PACKET FEEDBACK SHEET

The objective of the following questionaire is to help the instructor respond to student needs and to improve his instruction. Your feedback would be most helpful. Do not sign your name. No grade is attached to this exercise.

1. Circle each of the words that tell how you feel (mostly) about the subject of this packet.

interesting	boring	worthless	dull	fun
too hard	exciting	useful	cool	square
useless	too easy	groovy	uptight	very important

2. What did you like most about this topic?

3. The instructions for this packet were: (circle one)

   a. very clear.
   b. somewhat clear.
   c. vague.
   d. no help.

4. What did you like least about this topic?

5. How would you improve the packet?

6. How interested are you in finding out more about the subject of this packet?

   a. very interested.
   b. somewhat interested
   c. don't care either way.
   d. not too interested.
   e. not at all interested.

7. Miscellaneous comments about this packet? In general.

8. Comments about specific parts of this packet.

9. What do you like most about this packet format?

10. What do you like least about this packet format?

11. Comments, questions, and/or criticisms of this evaluation form?

DDT 106, F85, Packet # 4 , Title Page, Instructor: Bryenton

Packet Topic: Retaining Walls

Course #	:	DDT 106
Course Title	:	Structural Systems II
Course Content	:	Concrete Construction
Packet Timing	:	6 class/lab hours (one week exposure)
Institution	:	Burlington County College
Revision #	:	Original
Instructor	:	David C. Bryenton
Support Grant	:	N. J. Dept. of Education, Voc. #SCDG-430, FY84

Packet Content :

Title Page	Page 1
Goals	2
Rationale	2
Objectives	2
Learning Activities	2-3
Assignment	3-4
Evaluation	4
Bibliography	4

Appendices

A. Computer Operation Schedule

B. Sample Program Print Out

C. Sample Program Diagrams

D. Homework Assignment

E. Homework Assignment Answers (not handed out to students)

F. Student Evaluation Form

DDT 106, F85, Packet # 4 , Goals, Rationale, Objectives, Learning Activities
Instructor: Bryenton

Goals. The general goal of this packet is to familiarize the students with solving retaining wall problems on the computer, using "user friendly" software. The prerequisite topics for starting this packet are a thorough knowledge of retaining wall design including the topics of types of footings, actual soil pressures, allowable soil pressures, design of wall footings, retaining wall geometry, material properties, section properties, and supporting calculations for all of the above.

Rationale. The reasons for studying retaining wall design on the computer are: 1. much more rapid solution of retaining wall problems is possible; 2. iteration of cyclical problem solutions may be done rapidly; and 3. the use of computerized retaining wall solutions is expanding rapidly in industry.

Objectives: 1. to familiarize students with using "user friendly" software to solve computer problems. (i.e. software that doesn't require prerequisite knowledge of a computer language like BASIC or FORTRAN).

2. to demonstrate to the student the solution of a medium complex retaining wall problem on the computer.

3. to have the students solve a similar but different retaining wall problem on the computer, using open lab exposure to computer facilities. The problem solution will take the form of: a. a computerized numerical solution plus; b. a diagram, including earth, concrete outline, steel placement, and dimensions.

Learning Activities: 1. The student will watch a 1-2 hour demonstration by the instructor, solving a practice retaining wall problem on a microcomputer[1], using "user friendly" software[2] to generate a numerical data solution.

Note: [1] Probably a DEC Rainbow 100 or an IBMPC.

[2] Disco-Tech's "Retwall" software program. (copyrighted material, 1979)

DDT 106, F85, Packet # 4 , Learning Activities (cont.), Assignment
Instructor: Bryenton

Learning Activities (cont.): 2. Student will solve a similar but different retaining wall problem on the computer using given software[2] to generate the numerical solution.

3. Student will construct a graph from the numerical data in item 2 (above) including: a. earth outlines; b. concrete outlines; c. steel placement; and d. dimensions.

4. Student will compare the numerical and graphical analysis of: a. the computer generated retaining wall; and b. the previously done hand calculations solution for a similar retaining wall from the same or previous course(s).

Assignment: Period 1, 2 hrs., meet in the computer lab, room _____, main campus, and with the Instructor demonstrate a retaining wall design problem on the computer. Be prepared to take copious notes on the operation of the computer and the appropriate software.

See the attached computer operation schedule in the Appendix, Page A1 . Follow the Instructor as s/he demonstrates the program operation, asking questions and making notes in the right hand (blank) columns when appropriate.

Period 2, 2 hrs., work through the practice program the Instructor demonstrated in lecture until your printout matches the sample numerical results given by the Instructor, Appendix, Page B1 . This assures computer and software are working properly.

Start on the problem given in your packet on Page D1 , Appendix, to produce a numerical solution. The steps for computer and software operation are the same as for the practice program.

Resources available include: a. software literature; b. hardware literature; c. this packet; d. your textbook (course content); e. lab supervisor; and f. your Instructor. The literature will be available in the computer laboratory.

Note: [2]Disco-Tech's "Retwall" software program (copyright 1979)

DDT 106, F85, Packet # 4 , Assignment (cont.), Evaluation, Bibliography
Instructor: Bryenton

Assignment (cont.): Period 3, 2 hrs., complete your assigned retaining wall analysis problem, obtaining numerical data from the computer, printed on 8½ x 11 sheets and constructing the following end wall diagram to suit the data, including: a. earth; b. concrete; c. steel; and d. complete dimensions.

Open lab time will be available, if needed, to complete the computer analysis. See the lab supervisor.

Evaluation: The student product of this packet will include: a. a print out of the computer analysis of the assigned problem; and b. the diagram mentioned above.

The student's answer will be evaluated by comparison with the Instructor's answer. (The problems will be individual where possible).

The homework problem is the test on this packet. There will be no separate test on this packet except possibly some general questions on the final examination.

Bibliography:

1. Design of Reinforced Concrete by Jack McCormac, Harper and Row Publishers, New York, 1978.

2. Disco-Tech Software Instruction Manual Retwall-1, by Disco-Tech, a division of Morton Technologies, Inc., Santa Rosa, California, 1982.

3. "Retwall" software program from source in Item 2, above.

4. Owner's Manual, User's Guide, and Starting-Out Manual for the DEC Rainbow 100 Computer, by the Digital Equipment Corporation, 1982.

5. Installing and Using the LA50 Printer, EK-OLA50, VG-001, by Digital Equipment Corporation, 1982, Maynard, Mass.

APPENDIX A

Computer Operation Schedule: Retwall-1, Retaining Wall Design Program
Disco-tech "Retwall" Design Example
No. 1, (Copyright 1979.

1. These notes are for playing the above software on the DEC Rainbow Microcomputer with two disk drives and 256k memory.

2. Charge the computer with CP/M 86 operating system.

3. Insert prepared "Retwall" disk into drive A.

4. Insert "Retwall" data disk into drive B.

5. Type "RETWALL" after the blinking cursor.

6. Follow the Disco-tech "retwall" Instruction Manual, step by step, pp. 34-39.

7. Reproduce the printout sheets for this problem exactly as shown in the manual and you will be sure that the hardware, and the software are working properly.

8. You are now ready to tackle the Homework Problem #1, shown in Appendix D.

APPENDIX B

DDT106, f85, Packet #4, Retaining Wall Design Example No. 1. (Disco-tech "Retwall" software, Copyright 1979, Instruction Manual, pp. 34-39. (Follow the steps for a computerized solution.)

Design Example No. 1: Design a retaining wall to meet the following criteria:

a. Soil Density, 100 pcf.

b. Equivalent fluid pressure, 30 psf/ft. of depth.

c. Allowable Bearing Pressure, 2000 psf.

d. Lateral Bearing Pressure, 400 psf.

e. Frictional coefficient, 0.4

f. f_c' = 3000 psi

g. No slab over toe.

h. Height of fill, 15.5'.

i. Level backfill.

j. zero surcharge.

k. Use poured concrete, f_c' =3000 psi.

l. Tapered wall, 12" at the top.

m. d = 9.7".

Trial and Error Mode, Variables	Outputs
a. toe length	a. toe pressure
b. base length	b. Heel pressure
c. Axial load	

Note: 1. Strive to make the force resultant fall within the middle third of the base.

2. Draw a diagram of the final retaining wall with dimensions. (See page Appendix B3.) Various soluntions are possible.

APPENDIX B2

Cont.

JOB NUMBER: 101
JOB DESCRIPTION: RETAINING WALL DESIGN EXAMPLE NO. 1.

B A S E D E S I G N

SOIL DENSITY.....	100	PCF
ALLOWABLE BEARING PRESSURE.....	2,000	PSF
LATERAL BEARING PRESSURE.....	400	PSF/FT.
COEFFICIENT OF FRICTION.....	0.40	
F OF BASE CONCRETE.....	3,000	PSI

THERE IS NOT A SLAB OVER THE TOE.
SLOPE OF BACKFILL (RISE/RUN)..... 0.00

IMPOSED AXIAL LOAD..... 0 PLF

DESIGN TOE LENGTH.....	3.50	FT.
DESIGN BASE LENGTH.....	8.75	FT.
DESIGN EFFECTIVE DEPTH.....	8.66	IN.
TOE STEEL.....	0.799	SQ. IN. / FT.
HEEL STEEL.....	0.776	SQ. IN. / FT.
DESIGN TOE PRESSURE.....	1,819	PSF
DESIGN HEEL PRESSURE.....	484	PSF

NO KEY IS NEEDED.
OVERTURNING SAFETY FACTOR..... 2.6

(Over)

APPENDIX B1

RLINGTON COUNTY COLLEGE, DIVISION OF MATH, SCIENCE AND TECHNOLOGY, PEMBERTON-BROWNS-MILLS RD., PEMBERTON, N.J. 08068
Disco-tech Software, "Retwall", (Copyright), Instructional Manual, pp. 34-39

DATE: 7/26/84
JOB NUMBER: 101
JOB DESCRIPTION: RETAINING WALL DESIGN EXAMPLE NO. 1.

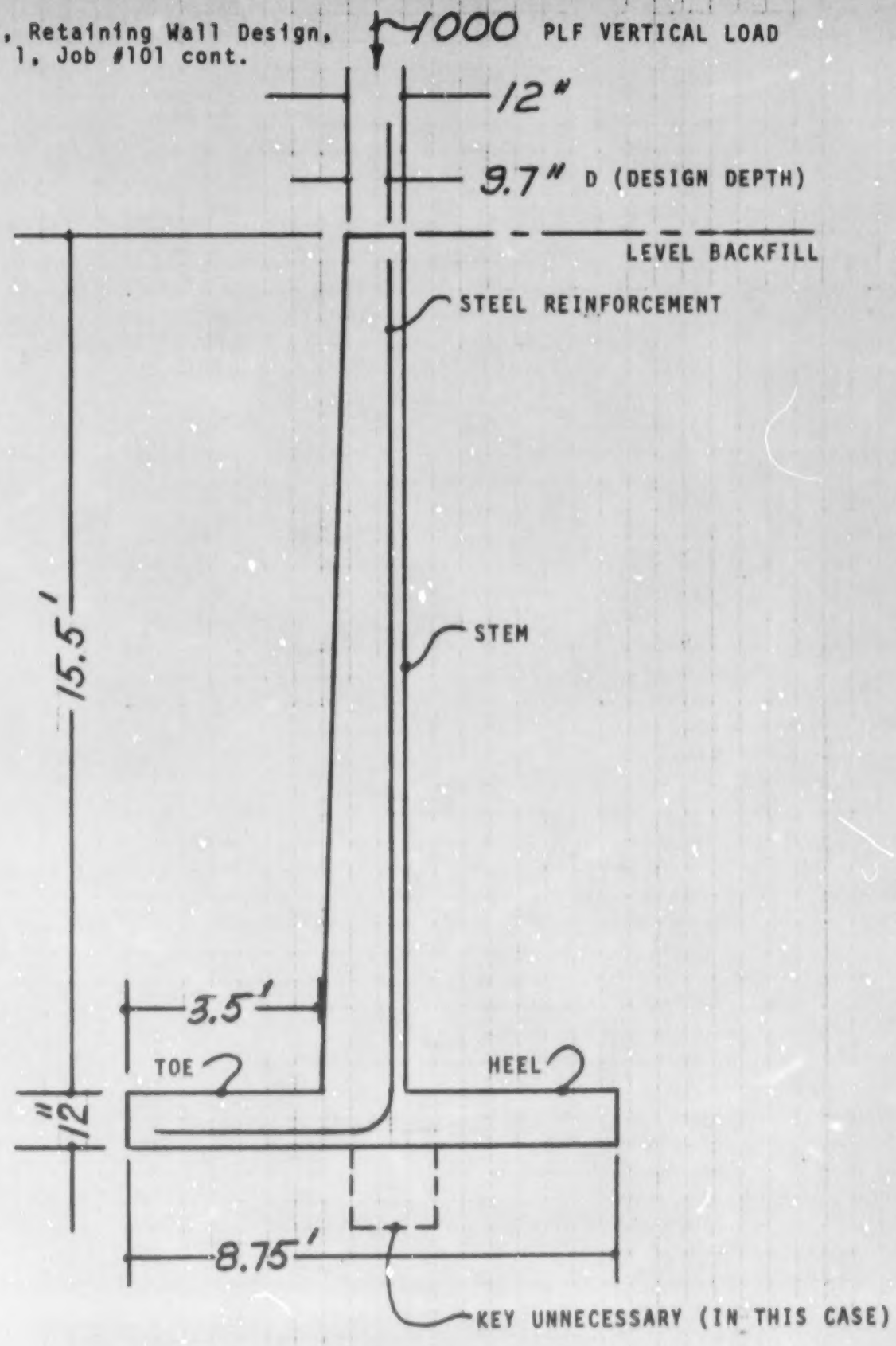
R E T A I N I N G W A L L D E S I G N

STEM DESIGN OF POURED CONCRETE; FC'.. 3,000 PSI
DESIGN STEEL STRESS..... 20,000 PSI
EQUIVALENT FLUID PRESSURE..... 30 PCF
SURCHARGE..... 0.00 FT

S T E M M O M E N T S A N D S H E A R S

DISTANCE FROM TOP OF WALL(FT)	SHEARS POUNDS	MOMENTS FOOT-LBS.
1	15	5
2	60	40
3	135	135
4	240	320
5	375	625
6	540	1,080
7	735	1,715
8	960	2,560
9	1,215	3,645
10	1,500	5,000
11	1,815	6,655
12	2,160	8,640
13	2,535	10,985
14	2,940	13,720
15	3,375	16,875
15.50	3,604	18,619

DISTANCE FROM TOP OF WALL(FT)	DESIGN DEPTH(IN)	AREA OF STEEL(SI)	COMP STRESS	SHEAR STRESS
1	9.70	0.00	0	0.1
2	9.70	0.00	3	0.6
3	9.70	0.01	9	1.3
4	9.70	0.02	20	2.4
5	9.70	0.04	40	3.7
6	9.70	0.08	68	5.3
7	9.70	0.12	109	7.2
8	9.70	0.18	162	9.5
9	9.70	0.26	231	12.0
10	9.70	0.35	316	14.8
11	9.70	0.47	421	17.9
12	9.70	0.61	547	21.3
13	9.70	0.78	695	25.0
14	9.70	0.97	868	29.0
15	9.70	1.20	1,068	33.3
15.50	9.70	1.32	1,178	35.5


4000 PLF VERTICAL LOAD
12"
9.7" D (DESIGN DEPTH)
LEVEL BACKFILL
STEEL REINFORCEMENT
15.5'
STEM
3.5'
TOE
HEEL
12"
8.75'
KEY UNNECESSARY (IN THIS CASE)

APPENDIX D

DDT106, F85, Packet #4, Retaining Wall Homework Problem No. 1. (solution using Disco-tech "Retwall" software, Copyright 1979. Follow the steps in the instruction Manual for "Retwall", pp. 34-39)

Homework Problem #1: Design a retaining wall to meet the following criteria:

a. Soil density, 100 pcf.

b. Equivalent fluid pressure, 30 psf / ft. of depth.

c. Allowable Bearing pressure, 4000 psf.

d. Lateral bearing pressure, 400 psf / ft.

e. Frictional coefficient, 0.5.

f. f_c' = 3000 psi.

g. There is a slab over the toe.

h. Height of fill, 21 ft.

i. Level backfill.

j. Surcharge, 3.0 ft.

k. Use poured concrete, f_c' = 3000 psi.

l. Tapered wall, use 12" at the top.

m. d = 10.05"

Trial and Error Mode Variables	Outputs
a. toe length	a. toe pressure
b. base length	b. heel pressure
c. Axial load	

Note: 1. Strive to make the force resultant fall within the middle third of the base length.

2. Draw a diagram of the final retaining wall with dimensions.

(See page Appendix E3.) Various solutions are possible.

BURLINGTON COUNTY COLLEGE, COURSE: DDT106 INSTR:BYRENTON, DISCO-TECH SOFTWARE, "Retwall" (Copyright 1979), Appendix E1, Homework Problem No. 1.

DATE: 7/25/84
JOB NUMBER: 102
JOB DESCRIPTION: RETAINING WALL DESIGN HOMEWORK PROBLEM #1

R E T A I N I N G W A L L D E S I G N

STEM DESIGN OF POURED CONCRETE; FC'..	3,000	PSI
DESIGN STEEL STRESS.....	20,000	PSI
EQUIVALENT FLUID PRESSURE.....	30	PCF
SURCHARGE.....	3.00	FT

S T E M M O M E N T S A N D S H E A R S

DISTANCE FROM TOP OF WALL(FT)	SHEARS POUNDS	MOMENTS FOOT-LBS.
1	105	50
2	240	220
3	405	540
4	600	1,040
5	825	1,750
6	1,080	2,700
7	1,365	3,920
8	1,680	5,440
9	2,025	7,290
10	2,400	9,500
11	2,805	12,100
12	3,240	15,120
13	3,705	18,590
14	4,200	22,540
15	4,725	27,000
16	5,280	32,000
17	5,865	37,570
18	6,480	43,740
19	7,125	50,540
20	7,800	58,000
21	8,505	66,150

DISTANCE FROM TOP OF WALL(FT)	DESIGN DEPTH(IN)	AREA OF STEEL(SI)	COMP STRESS	SHEAR STRESS
1	10.05	0.00	3	1.0
2	10.40	0.01	12	2.2
3	10.75	0.03	28	3.6
4	11.11	0.06	50	5.2
5	11.46	0.11	79	6.9
6	11.81	0.16	115	8.7
7	12.16	0.22	158	10.7
8	12.51	0.30	207	12.8
9	12.86	0.39	262	15.1
10	13.22	0.49	324	17.4
11	13.57	0.61	391	19.8
12	13.92	0.75	465	22.3

Burlington County College, Course DDT106, Instr: Bryenton, Disco-tech software, "Retwall" (Copyright 1979), Appendix E2, Homework Prob. No. 1.

Cont.

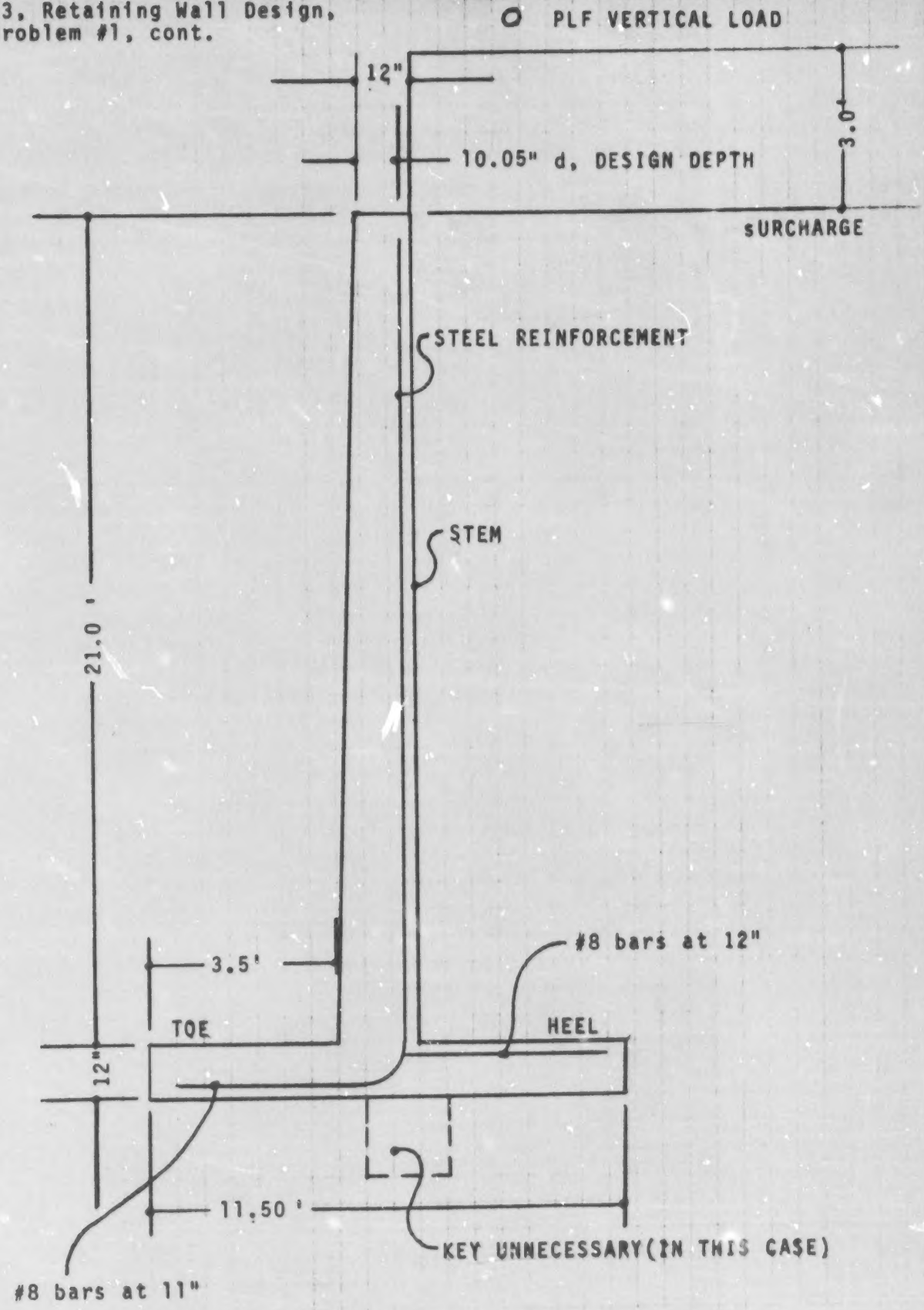
13	14.27	0.90	544	24.8
14	14.62	1.06	628	27.5
15	14.97	1.24	717	30.2
16	15.32	1.44	811	32.9
17	15.68	1.65	910	35.8
18	16.03	1.88	1,014	38.7
19	16.38	2.12	1,122	41.6
20	16.73	2.39	1,234	44.6
21	17.08	2.67	1,350	47.6

JOB NUMBER: 102
JOB DESCRIPTION: RETAINING WALL DESIGN HOMEWORK PROBLEM #1

B A S E D E S I G N

SOIL DENSITY.....	100	PCF
ALLOWABLE BEARING PRESSURE.....	4,000	PSF
LATERAL BEARING PRESSURE.....	400	PSF/FT.
COEFFICIENT OF FRICTION.....	0.50	
FC OF BASE CONCRETE.....	3,000	PSI
THERE IS A SLAB OVER THE TOE.		
SLOPE OF BACKFILL (RISE/RUN).....	0.00	
IMPOSED AXIAL LOAD.....	0	PLF
DESIGN TOE LENGTH.....	3.75	FT.
DESIGN BASE LENGTH.....	11.50	FT.
DESIGN EFFECTIVE DEPTH.....	20.50	IN.
TOE STEEL.....	0.787	SQ. IN. / FT.
HEEL STEEL.....	1.265	SQ. IN. / FT.
DESIGN TOE PRESSURE.....	3,744	PSF
DESIGN HEEL PRESSURE.....	0	PSF

NO KEY IS NEEDED.
OVERTURNING SAFETY FACTOR..... 2.1


0 PLF VERTICAL LOAD
12"
10.05" d, DESIGN DEPTH
3.0'
SURCHARGE
STEEL REINFORCEMENT
STEM
21.0'
3.5'
#8 bars at 12"
TOE
HEEL
12"
11.50'
KEY UNNECESSARY(IN THIS CASE)
#8 bars at 11"

APPENDIX F

DATE: _____

COUSE: _____

PACKET #: _____

A PACKET FEEDBACK SHEET

The objective of the following questionaire is to help the instructor respond to student needs and to improve his instruction. Your feedback would be most helpful. Do not sign your name. No grade is attached to this exercise.

1. Circle each of the words that tell how you feel (mostly) about the subject of this packet.

interesting	boring	worthless	dull	fun
too hard	exciting	useful	cool	square
useless	too easy	groovy	uptight	very important

2. What did you like most about this topic?

3. The instructions for this packet were: (circle one)

   a. very clear.
   b. somewhat clear.
   c. vague.
   d. no help.

4. What did you like least about this topic?

5. How would you improve the packet?

6. How interested are you in finding out more about the subject of this packet?

   a. very interested.
   b. somewhat interested
   c. don't care either way.
   d. not too interested.
   e. not at all interested.

7. Miscellaneous comments about this packet? In general.

ELE 152
Lab #8 - Drawing Schematics with the Computer

Name_____

Introduction

In this laboratory you will be introduced to drawing electrical schematics using the Apple II computer and MICRO-CAP software. Two example problems and solutions are given for you in order to become familiar with the MICRO-CAP program. Next, a rough draft of a schematic (a different one for each student) will be given to you for which you are to develop the final schematic using MICRO-CAP.

Objectives

1. Given two example problems with solutions, verify each on the Apple computer using MICRO-CAP.

2. Given a rough draft of a schematic, develop the final schematic and provide a print out to the instructor.

Learning Activities (where a * appears before an activity, you must obtain the "instructor's OK" before proceeding)

*1. Show the instructor your "Lab preparation" problem.

2. Verify the "Easy Example" on P. 1-11 to 1-13 of the MICRO-CAP manual.

3. Verify the Example found in the Unit #8 Supplement: Helpful Hints to Using MICRO-CAP.

*4. Ask the instructor to select a schematic from those shown on the following pages. Develop the final schematic on the computer and provide the instructor with a print out of the schematic. If this schematic needs more work, you will be asked to modify it and resubmit it to the instructor.

Source:
Electronic Circuits Manual
by John Markus,
McGraw-Hill, 1971

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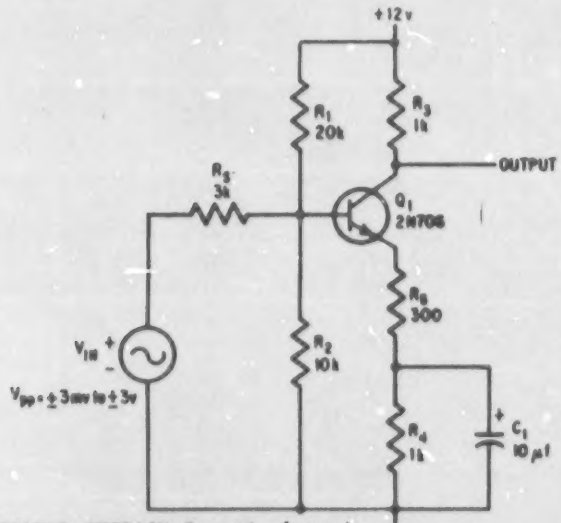
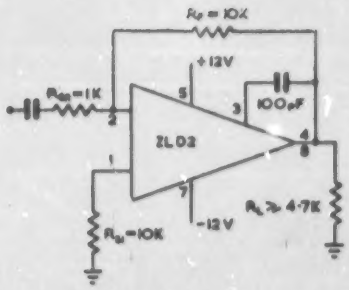
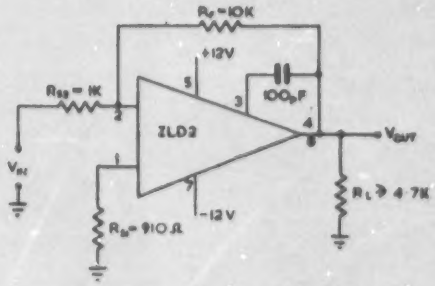


NEGATIVE FEEDBACK—Conventional transistor amplifier circuit shown uses negative feedback by R5 to increase input impedance, but does not give high voltage gain. Article gives design equations and tells how to add positive feedback for higher gain.—G. P. Klein, Combined Feedback Builds Gain and Input Impedance, *Electronics*, Oct. 16, 1967, p 99.

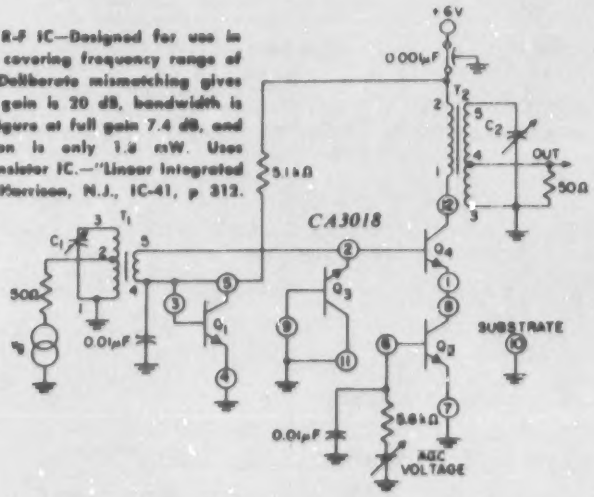


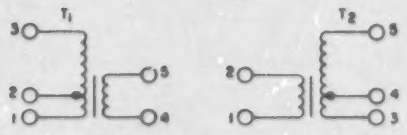
IC INVERTING A-C AMPLIFIER—Uses Ferranti ZLD2 IC differential-input d-c amplifier connected to give gain of 10 with negative feedback. Intended for applications where d-c component is not required, so capacitance coupling is used at input. This unbalances values of RS1 and RS2, for which correction is made by making RS1 equal to RF. Alternatively, RS1 can be 910 ohms and an additional 1K resistor connected between terminal 2 and ground.—Microlin Amplifiers ZLD2S and ZLD2T, Ferranti Ltd., Oldham, Lancs., England, No. 11, 1967.



INVERTING A-C OR D-C AMPLIFIER—Uses Ferranti ZLD2 IC differential-input d-c amplifier connected to give gain of 10 with negative feedback. Values shown give bandwidth of 1.5 MHz.—Microlin Amplifiers ZLD2S and ZLD2T, Ferranti Ltd., Oldham, Lancs., England, No. 11, 1967.

15-MHZ TUNED R-F IC—Designed for use in military receiver covering frequency range of 2 to 30 MHz. Deliberate mismatching gives stability. Total gain is 20 dB, bandwidth is 315 kHz, noise figure at full gain 7.4 dB, and power dissipation is only 1.8 mW. Uses CA3018 four-transistor IC.—"Linear Integrated Circuits," RCA, Harrison, N.J., IC-41, p 313.

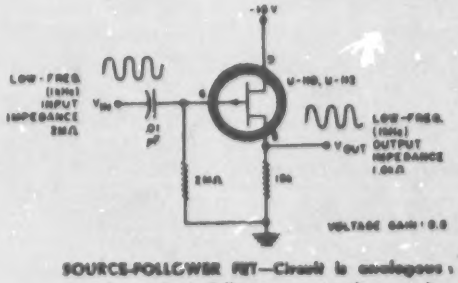




$L_1 = 0.8\ \mu H$
$Q_1 = 200$
$T_{1-3} = 6T$
$T_{1-2} = 1T$
$T_{3-4} = 2T$

$L = 0.8\ \mu H$
$Q_2 = 200$
$T_{5-6} = 6T$
$T_{7-8} = 4T$
$T_{6-8} = 1T$

#22 wire on Q-2 material, CF107 Toroid from Indiana General.
C_1, C_2 = Arco 425 or equiv.



SOURCE-FOLLOWER FET—Circuit is analogous to tube cathode-follower or transistor emitter-follower. Gives high input impedance, relatively low output impedance, and voltage gain close to unity. Frequency response is flat to 1 MHz.—J. N. Wojak, Jr. and M. E. McGee, Field-Effect Transistor Circuits, *Electronics World*, May 1967, p 32–33 and 78.

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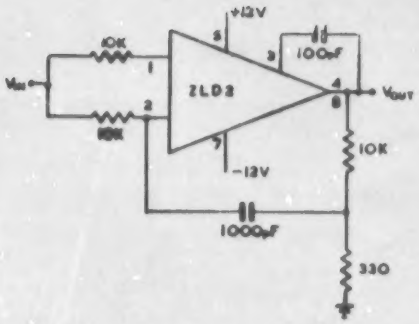
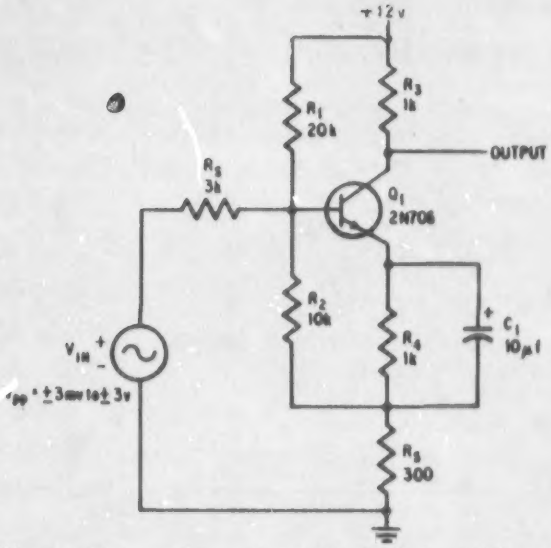
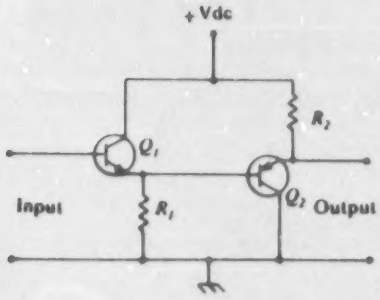


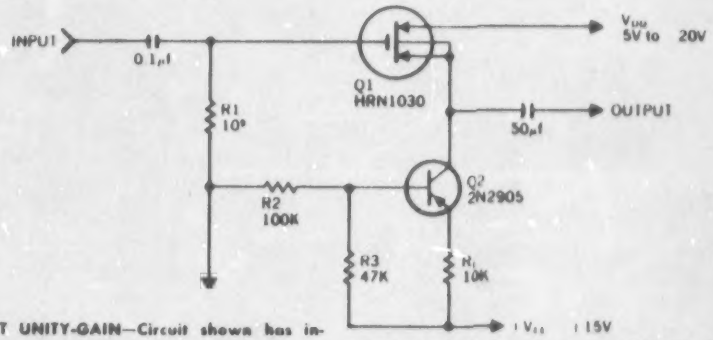
NONINVERTING WIDEBAND—Gives high input impedance, but is direct coupled and signal source must supply necessary base current for Ferranti ZLD2 IC differential-input d-c amplifier. Gain is 3 dB down at 220 Hz and 600 kHz.—*Microlin Amplifiers ZLD2S and ZLD2T*, Ferranti Ltd., Oldham, Lancs., England, No. 11, 1967.



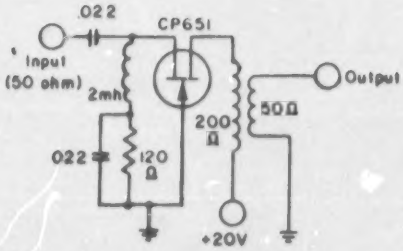
BOOTSTRAPPING—Combining positive and negative feedback in bootstrap amplifier gives both high input impedance and high voltage gain. Bootstrapping resistor R2 provides positive feedback. Article gives design equations.—G. P. Klein, Combined Feedback Builds Gain and Input Impedance, *Electronics*, Oct. 16, 1967, p 99.



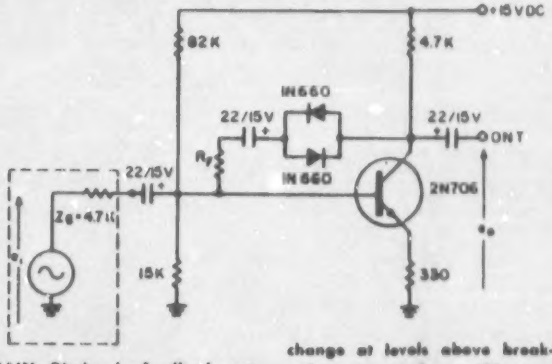
TEMPERATURE-STABLE EMITTER-FOLLOWER—With 2N700 for Q1 and 2N869 for Q2, average variation in output voltage will be only about 25 mV for temperature range of 20 to 200 F when R1 and R2 are 20K.—"Selected Electronic Circuitry," NASA SP-5046, 1966, Government Printing Office, Washington, D.C., p 68.



MOSFET UNITY-GAIN—Circuit shown has input impedance above 1,000 meg. Mosfet functions as source follower with constant-current generator instead of source resistance.—C. R. Perkins, "Application of MOSFET Devices to Electronic Circuits," Hughes, Newport Beach, Cal., 1968, p 10.



BROADBAND FET P...AMP—Gives bandwidth of 0.5 to 40 MHz for maximum input signal of 3 V p-p. Voltage gain is 10 dB, and dynamic range 140 dB.—FET Broadband R. F. Preamplifiers, Crystalonics, Cambridge, Mass., TN#1.



NONLINEAR GAIN—Diodes in feedback network are biased into conduction when signal excursions exceed 0.6 V p-p, and resulting negative feedback reduces gain of stage. Value of feedback resistor RF determines gain change at levels above break-point; typical values range from 470 to 10,000 ohms. Used to emphasize specific input levels.—J. K. Hickman, Complementary Diode Feedback Produces Nonlinear Gain, *Electronic Design*, June 7, 1965, p 42.

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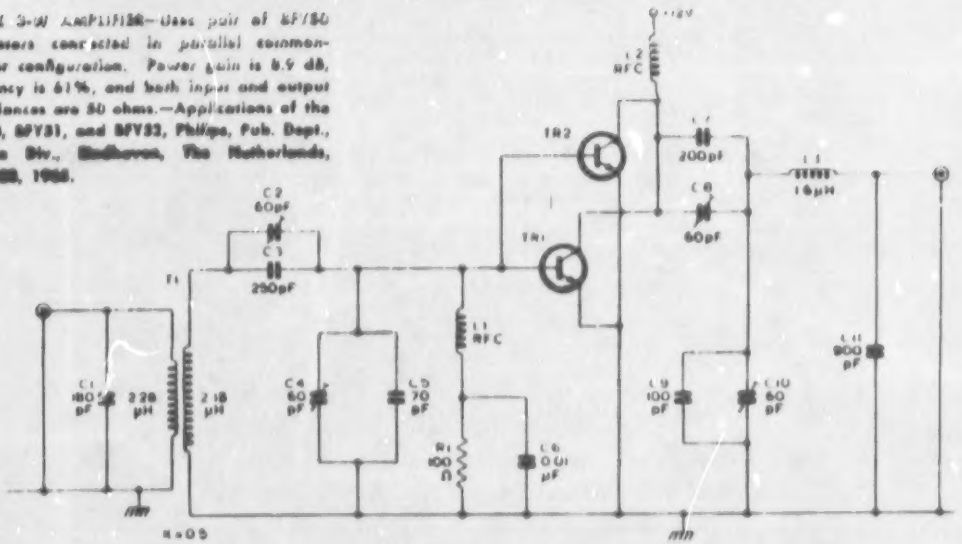
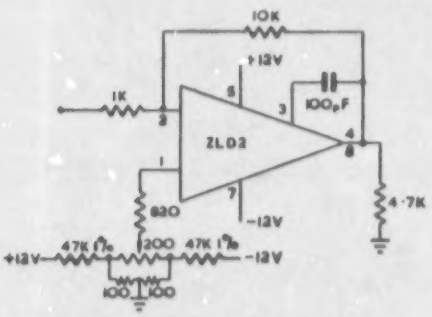
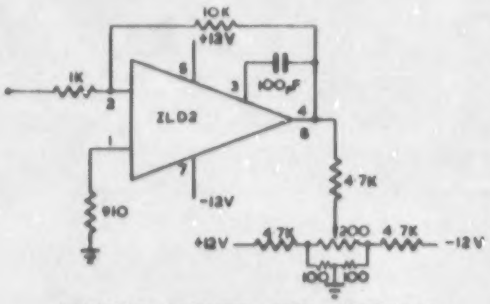
8-MHZ 3-W AMPLIFIER—Uses pair of BFY50 transistors connected in parallel common-emitter configuration. Power gain is 8.9 dB, efficiency is 61%, and both input and output impedances are 50 ohms.—Applications of the BFY50, BFY51, and BFY52, Philips, Pub. Dept., Elcoma Div., Eindhoven, The Netherlands, No. 428, 1966.

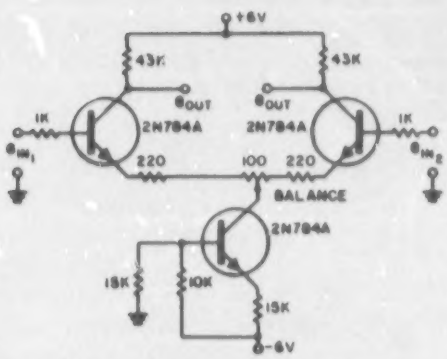




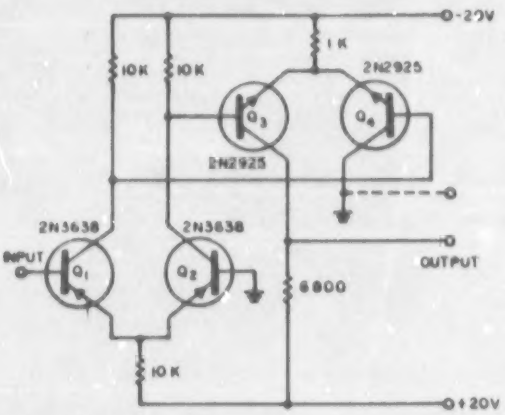
INVERTING AMPLIFIER WITH ADJUSTABLE INPUT BIAS—Provides gain of 10 and bandwidth of 1.5 MHz for either a-c or d-c inputs, with adjustable bias voltage applied to input for correcting offset voltage of amplifier, which may typically be about 20 mV.—Micro-lin Amplifiers ZLD2S and ZLD2T, Ferranti Ltd., Oldham, Lancs., England, No. 11, 1967.



INVERTING AMPLIFIER WITH ADJUSTABLE OUTPUT BIAS—Provides gain of 10 and bandwidth of 1.5 MHz for either a-c or d-c inputs, with adjustable bias voltage applied to output for correcting offset voltage of amplifier, which may typically be about 20 mV.—Micro-lin Amplifiers ZLD2S and ZLD2T, Ferranti Ltd., Oldham, Lancs., England, No. 11, 1967.



LONG LONG-TAIL PAIR—Drift is less than 75 μV per deg C referred to input, and differential mode voltage gain is 30. Addition of third transistor to differential pair improves common-mode rejection while requiring only extra −6 V source.—Differential Amplifier, Electronic Design, Feb. 3, 1964, p 44.



DIFFERENTIAL OUTPUT—Conventional differential-pair shown is often used as output stage of amplifier even though only one output phase is used. Q4 maintains gain at frequencies down to d-c without resorting to zener diode or large bypass capacitor.—S. G. Freshour, Differential Amplifier Offers Efficient, Dual Outputs, Electronic Design, July 19, 1965, p 37–38.

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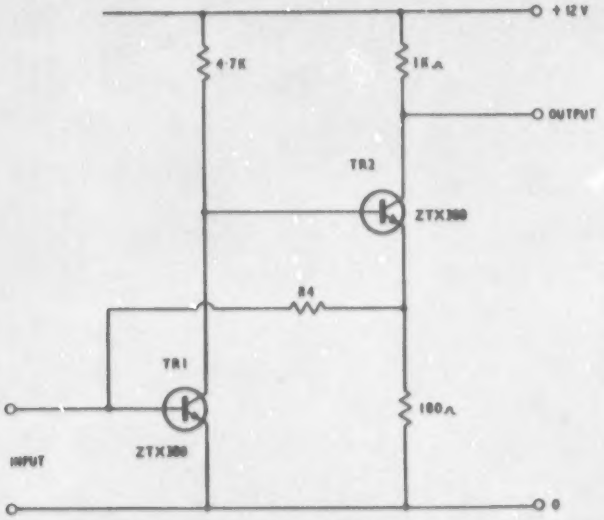
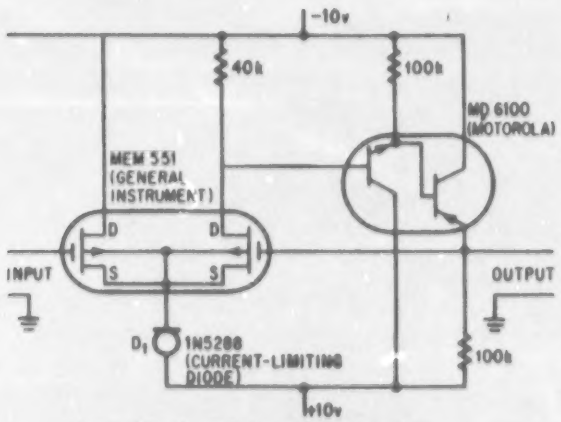
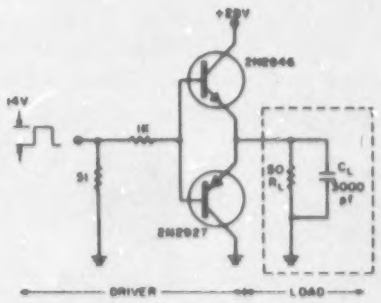


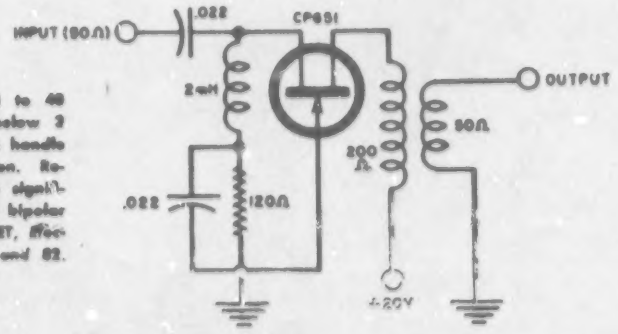
WIDEBAND CURRENT AMPLIFIER—Bandwidth is over 6 MHz, input impedance about 15 ohms, and output impedance 1K. Report gives design procedure. R4 determines current gain; 1.8K gives gain of 10 and bandwidth of 9 MHz, while 3.6K gives current gain of 20 and bandwidth of 6.5 MHz.—*S-Line Transistor Applications*, Ferranti Ltd., Oldham, Lancs., England, 1969, p 29.



BUFFER—Dual mosfet coupled to complementary transistor pair has excellent thermal stability and almost infinite impedance, for isolating high-impedance circuits. Maximum input current drawn is less than 0.1 pA.—*T. H. Lynch, MOS FET Amplifier Provides Almost Infinite Impedance, Electronics, July 24, 1967, p 88.*



CABLE-DRIVING PULSE AMPLIFIER—Upper transistor is turned on by pulse to drive 50-ohm line, and lower transistor turns on at end of pulse to discharge line capacitance, to improve waveshape and permit driving of longer lines. Area enclosed in dashed lines simulates worst-case line-load situation. With 2N2927 pnp, 14-V pulse decays in 75 ns; if 2N1132 is used instead, decay is 110 ns.—*Cable Driver Amplifier, Electronic Design, Feb. 3, 1964, p 44.*



POWER-FET FRONT END—Covers 0.5 to 40 MHz. Broadband noise figure is below 2 dB, with sufficient dynamic range to handle signals above 2 V with little distortion. Receiver sensitivity and selectivity are significantly better than that achieved with bipolar devices.—*J. Tamesaitis, The Power FET, Electronics World, June 1969, p 34–35 and 82.*

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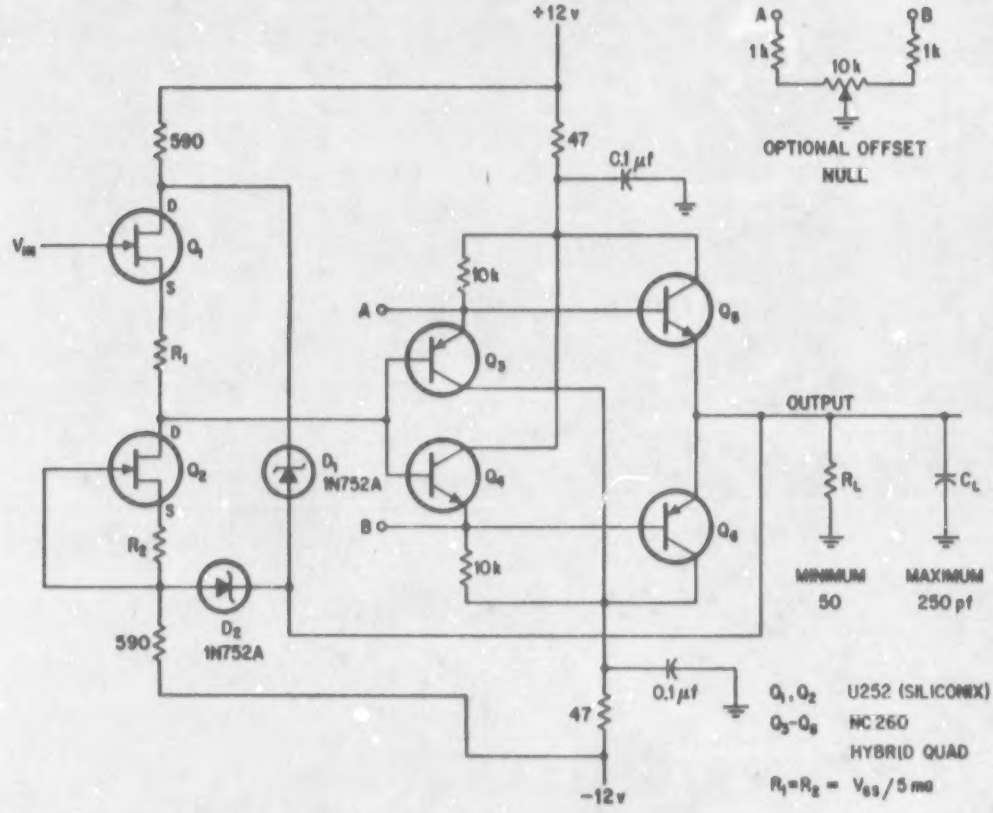
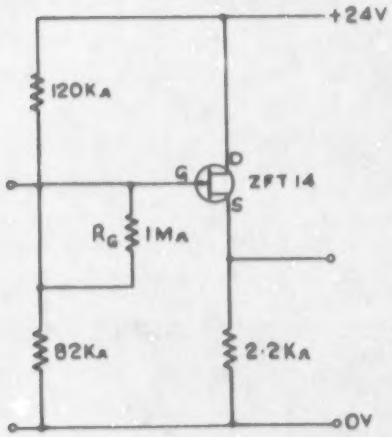
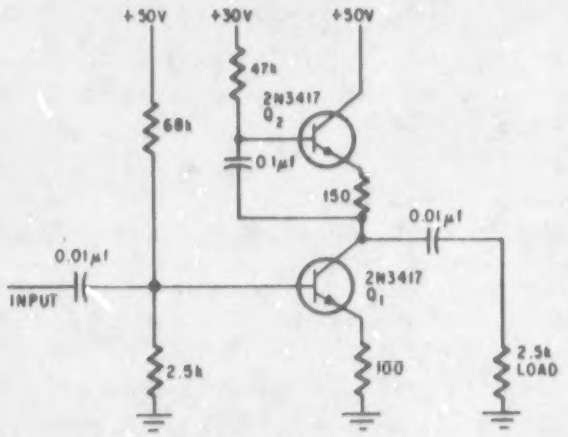


FAST-SETTLING BUFFER—Simple transistor circuit outperforms high-speed fet opamps used in sampling circuits and analog memories by settling to 0.1% of final value in 50 ns. Circuit is stable with moderate capacitive loading and will slew at up to 300 V per μs. Potentiometer can be connected to A and B to null the offset voltage. Bode plot is flat from d-c to 40 MHz.—D. Atlas, FET Buffer Boosts High Speed and Performance, *Electronics*, July 21, 1969, p 82–83.



FET SOURCE FOLLOWER—Uses voltage divider to provide bias for gate. Input impedance is 1 meg.—Field Effect Transistors and Applications, Ferranti Ltd., Oldham, Lancs., England, No. 22, 1965.



CONSTANT-CURRENT SOURCE—Q2 offers high impedance to amplifier, and requires only bias current to develop output voltage. Practically all of collector-current modulation of Q1 is delivered to load; thus, collector current of 2 mA p-p produces 1-mA p-p in load, whereas 2.5K resistor in place of Q2 would require 4-mA p-p input for same output. Maximum output power is over 0.2 W at 22 V.—M. J. Wright, Transistor Replaces Resistor and Improves Amplifier, *Electronics*, Jan. 8, 1968, p 92.

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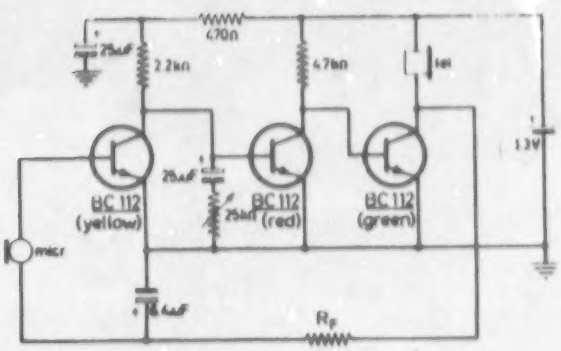
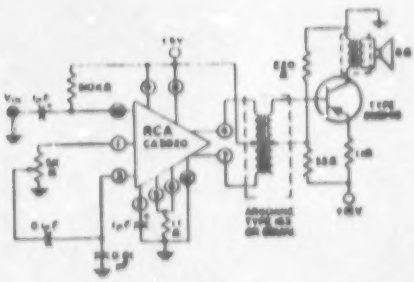
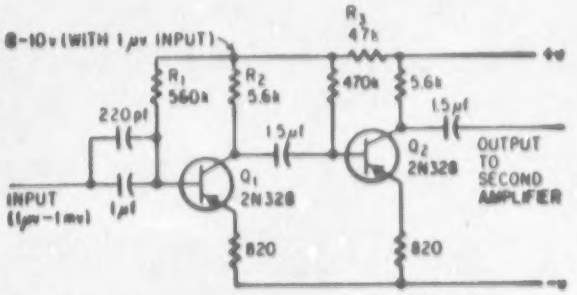


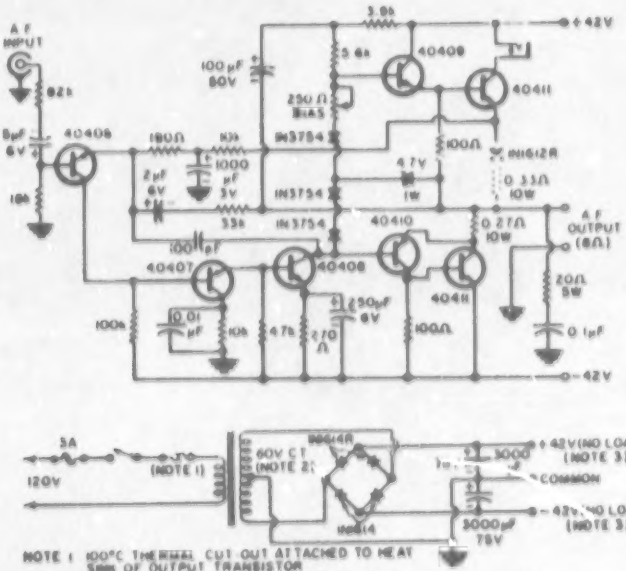
1-MW HEARING AID—Three-transistor circuit provides adequate power for conventional behind-the-ear hearing aid. Requires only 25K volume control, low enough to be reliable as miniature pot. Input can range from 100 μV to 5 mV. Value of RF depends on transistor currents; average value is 350K.—A. M. Aalbers and A. M. Peters, The Microminiature Transistor BC112 Employed in a Direct Coupled Hearing Aid Amplifier with 1 mW Output, Philips, Pub. Dept., Eindhoven, The Netherlands, No. 138, 1964.

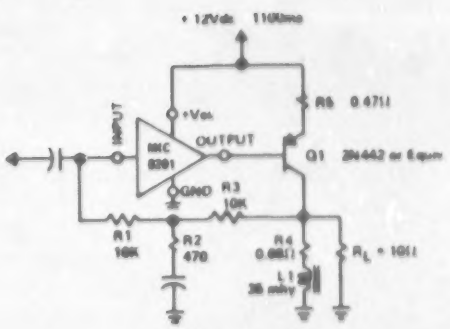


4-W CLASS-A AMPLIFIER WITH IC—Integrated circuit provides 58 dB power gain in driving transistor output stage through coupling transformer.—D. E. Lancaster, Audio Integrated Circuits—What's Available?, Electronics World, Oct. 1967, p 34–36.

SEISMIC AMPLIFIER—Can amplify faint echoes of distant explosive charge without being saturated by direct sound of underground explosion used in geophysical prospecting. Gain is about 25 for microvolt inputs, and decreases automatically as input increases to millivolt levels. Only first stage is shown; five stages give maximum overall gain of 1,000,000 and input dynamic range of 60 dB from 1-μV minimum signal. Third stage has manual level control that adjusts gain without affecting frequency response or dynamic range.—G. S. Lehsten, Audio Amplifier Adjusts Gain to Input Levels, Electronics, May 29, 1967, p 86–87.







6-W IC WITH SERIES-SHUNT A-C FEEDBACK—Input impedance is 1K but circuit retains high sensitivity (20 mV input for 2 W output) even with feedback from output transistor to Mallory MIC0201 IC input. Distortion is about 10% for 6 W but less than 5% up to 4.5 W.—M. L. Deschler, Integrated Circuit Audio Driver Amplifier, Mallory, Indianapolis, Ind., APP16-1, 1966.

70-W HI-FI—Response is flat within 1 dB from 5 to 25,000 Hz. Diodes in driver stage are thermally connected to output transistor heat sinks, to maintain preset 20 mA of quiescent output current at case temperatures up to 100 C. Other circuit features contribute to stability and reliability.—R. D. Gold and J. C. Sondermeyer, Designing Silicon-Transistor Hi-Fi Amplifiers, Electronics World, Nov. 1966, p 47–50 and 80–81.

BURLINGTON COUNTY COLLEGE
PEMBERTON, NEW JERSEY

DDT 104 - BUILDING CODES, SPECIFICATIONS AND COST ESTIMATING

INSTRUCTIONAL UNIT

NO. 6 - COMPUTERIZED SPECIFICATION WRITING FOR ARCHITECTURAL PROJECTS

DDT 104 - BUILDING CODES, SPECIFICATIONS AND COST ESTIMATING

INSTRUCTIONAL UNIT

NO. 6 - COMPUTERIZED SPECIFICATION WRITING FOR ARCHITECTURAL PROJECTS

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INSTRUCTIONAL UNIT NO. 6

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Evaluation
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Computer and Specification Procedure

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UNIT NO. 6: COMPUTERIZED SPECIFICATION WRITING FOR ARCHITECTURAL PROJECTS

COURSE: DDT 104 - BUILDING CODES, SPECIFICATIONS AND COST ESTIMATING

INSTRUCTOR:

RATIONALE: The specifications give detailed instructions on the required materials, finishes, and workmanship--all grouped by building trades. Each trade is included in the order of actual construction. Specifications are the written instructions required to supplement the drawings for a construction project. The intent of the specifications should always be to clarify or describe in the simplest terms the items necessary to complete the scope of the work for the project. Ideally, the drawings show the form of construction, whereas the specifications establish its quality. The specifications list the construction materials and equipment in terms of general requirements, specific products and execution.

Since the use of micro-computers is rapidly expanding in the architectural, engineering, and construction fields, this unit will introduce the latest professional methods and the use of micro-computers for data and word processing in specification writing.

CONCEPTS TO BE MASTERED:

1. The production of computerized architectural specifications.
2. Selection of construction materials and products.

OBJECTIVES:
1. The students will produce a complete set of computerized architectural specifications using the CSI format. Each student will be responsible for one (1) division of specifications as assigned by the Instructor. This division will also be the basis for the assigned report on the unit and final materials and/or product selection.
2. Using the computerized specifications, the student will further understand the data content and format of specifications for architectural projects.

LEARNING PROCEDURES:

1. Read and study Chapter 12 of "Architectural Working Drawings", Liebing and Paul.

2. Read and study the Construction Specifications Institute (CSI) format.
   Appendix G, "Architectural Working Drawings", Liebing and Paul.

3. In-class observation of computerized architectural specification production demonstrated by Instructor.

4. Student production of one (1) division of computerized architectural specifications. Division selection to be assigned by Instructor.

5. Read and study specification division for revisions as required.

6. Revise and/or edit specification division as required for submittal.

ASSIGNMENT:

1. Produce computer "hard copy" of assigned division.

2. Review "hard copy" and note deletions, additions and selections.

3. Submit division for final approval of all proposed changes.

4. Produce final division specification as required.

5. Submit final copy and rough draft of assigned division of specifications.

EVALUATION:

1. The final revised edition of the assigned division of specifications assignment will be worth 100 points.

2. There will be an examination covering the three (3) units on specifications. The exam will be worth 100 points.

INSTRUCTIONAL MODES:

1. Class discussion on unit.
2. Demonstration on micro-computer.
3. Student production of one division of specifications on micro-computer.
4. Individual review of assigned specification division.
5. Specification assignment.
6. Examination.

BURLINGTON COUNTY COLLEGE

DDT 104

UNIT NO. 6: COMPUTERIZED SPECIFICATION WRITING FOR ARCHITECTURAL PROJECTS

INSTRUCTOR:

ASSIGNMENT:

Monday, (date), 3 hrs.

Class will meet in the computer lab, Room _____, to watch the Instructor demonstrate the production of a division of specifications on micro-computer.
Be prepared to take notes on the operation of the computer and the software.
Instructor will assign divisions of specifications to students.
(See attached Appendix A)

Wednesday, (date), 3 hrs.

Student will work through the program and produce assigned unedited division of specifications as required.
Technical Assistance available for the assignment include:

1. software literature
2. hardware literature
3. this unit of instruction
4. lab supervision
5. the Instructor

(Refer to Appendix B)

Homework:

Review assigned unedited division of specifications and make all proposed deletions, additions and selections as required.

Monday, (date), 3 hrs.

Complete proposed deletions, additions and selections as required.
Submit to Instructor for individual review and comment.

Wednesday, (date), 3 hrs.

Make proposed deletions, additions and selections to assigned division of specifications and produce final hard copy.
(Refer to Appendix C)
Assignment due: Monday, (date)

EVALUATION:

The student submittal for this unit will include:

1. Rough draft of assigned division of specifications with deletions, additions and selections

2. Final copy of specification division as required.

Evaluation will be made on the content and accuracy of specification division.
The assignment will be worth 100 points.

APPENDIX A

CONSTRUCTION SPECIFICATIONS INSTITUTE (CSI) FORMAT

CONTENTS OF DISCO-SPECS SOFTWARE PROGRAM	FILE CODE
DIVISION 0 - BIDDING AND CONTRACT REQUIREMENTS	DIV0.DAT
SECTION 00100 - INSTRUCTIONS TO BIDDERS	
SECTION 00300 - BID/TENDER FORMS	
SECTION 00500 - AGREEMENT FORMS	
SECTION 00700 - GENERAL CONDITIONS OF THE CONTRACT	
DIVISION 1 - GENERAL REQUIREMENTS	DIV1.DAT
SECTION 01010 - SUMMARY OF WORK	
SECTION 01040 - COORDINATION	
SECTION 01300 - SUBMITTALS	
SECTION 01500 - CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS	
SECTION 01600 - MATERIAL AND EQUIPMENT	
SECTION 01700 - CONTRACT CLOSEOUT	
DIVISION 2 - SITE WORK	DIV2.DAT
SECTION 02210 - SITE GRADING	
SECTION 02220 - STRUCTURE EXCAVATION AND BACKFILLING	
SECTION 02513 - ASPHALTIC CONCRETE PAVING	
SECTION 02577 - PAVEMENT MARKING	
DIVISION 3 - CONCRETE	DIV3.DAT
SECTION 03300 - CAST-IN-PLACE CONCRETE	
DIVISION 4 - MASONRY	DIV4.DAT
SECTION 04100 - MORTAR	
SECTION 04220 - CONCRETE UNIT MASONRY	
DIVISION 5 - METALS	DIV5.DAT
SECTION 05120 - STRUCTURAL STEEL	
SECTION 05300 - METAL DECKING	
SECTION 05500 - METAL FABRICATIONS	
DIVISION 6 - WOOD AND PLASTICS	DIV6.DAT
SECTION 06000 - CARPENTRY, MILLWORK, AND RELATED ITEMS	
SECTION 06181 - GLUE-LAMINATED STRUCTURAL UNITS	

DIVISION 7 - THERMAL AND MOISTURE PROTECTION	DIV7.DAT
SECTION 07500 - MEMBRANE ROOFING	
SECTION 07600 - FLASHING AND SHEET METAL	
SECTION 07900 - SEALANTS	
DIVISION 8 - DOORS AND WINDOWS	DIV8.DAT
SECTION 08100 - METAL DOORS AND FRAMES	
SECTION 08120 - ALUMINUM DOORS AND FRAMES	
SECTION 08210 - WOOD DOORS	
SECTION 08700 - HARDWARE	
SECTION 08800 - GLAZING	
DIVISION 9 - FINISHES	DIV9.DAT
SECTION 09260 - GYPSUM WALLBOARD SYSTEMS	
SECTION 09310 - CERAMIC TILE	
SECTION 09510 - ACOUSTICAL CEILINGS	
SECTION 09650 - RESILIENT FLOORING	
SECTION 09900 - PAINTING	
DIVISION 10- SPECIALTIES	DIV10.DAT
SECTION 10050 - MISCELLANEOUS SPECIALTY ITEMS	
SECTION 10150 - COMPARTMENTS AND CUBICLES	
SECTION 10800 - TOILET AND BATH ACCESSORIES	
DIVISION 11- EQUIPMENT (NOT INCLUDED)	-
DIVISION 12- FURNISHINGS (NOT INCLUDED)	-
DIVISION 13- SPECIAL CONSTRUCTION	DIV13.DAT
SECTION 13122 - METAL BUILDING SYSTEM	
DIVISION 14- CONVEYING SYSTEMS (NOT USED)	-
DIVISION 15- MECHANICAL	DIV15.DAT
SECTION 15400 - PLUMBING SYSTEMS	
SECTION 15800 - AIR DISTRIBUTION	
DIVISION 16- ELECTRICAL	DIV16.DAT
SECTION 16400 - SERVICE AND DISTRIBUTION	

APPENDIX B COMPUTERIZED SPECIFICATION PROCEDURE

Required hardware: DEC Rainbow 100 Computer
2 disk drives, 128K
DEC LA50 Printer

Required software: Wordstar and Disco-Specs Architectural Specification-Writing Data Package

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PROCEDURE:

1. Press computer start button #1.

2. Wait for "menu" to appear on screen.

3. Insert software disk A (CP/M 86-80 and Wordstar) into drive A. Press A on keyboard. This loads CP/M 86-80 into computer.

4. When red light goes out on drive A, insert software disk B (Disco-Specs) into drive B.

5. With screen displaying A> type WSU This will load software program into computer.

6. Screen will display Wordstar Opening Menu. Type L to log-in another disk drive.

7. Computer will ask what drive to log-in. Type B: <RETURN> This logs-in drive B into the computer.

8. Type D to edit a document file.

9. Computer will ask "Name of File to Edit?"

10. Type in file name for the division you want to work on.
Refer to List of Files (see Appendix A)
EXAMPLE:
Type DIV 3. DAT <RETURN> FOR DIVISION 3 - CONCRETE

11. Selected File will appear on screen and you are ready to edit or review.

12. Read through the file and press "Next Screen" on keyboard to go through the file until you see "END OF SECTION". Make note of page number at top of screen.

13. Press ^KD to return to Opening Menu.

14. With Opening Menu displayed on screen, Type P to print a file.

15. Computer will ask "Name of File to Print" Type in File Code for the division you are working on.
EXAMPLE:
Type DIV 3. DAT <RETURN> FOR DIVISION 3 - CONCRETE

16. Computer will ask a series of questions:

QUESTION		ANSWER
A. DISK FILE OUTPUT (Y/N)	-	N
B. START AT PAGE (NO. THEN RETURN)	-	1 <RETURN>
C. STOP AFTER PAGE (NO. THEN RETURN)	-	(REFER TO STEP #12 FOR LAST PAGE AT END OF SECTION) <RETURN>
D. USE FORM FEEDS (Y/N)	-	N
E. SUPPRESS PAGE FORMAT (Y/N)	-	N
F. PAUSE FOR PAPER CHANGE (Y/N)	-	Y
G. READY	-	Prepare LA50 Printer before printing file (see Step #17)

17. Procedure for LA50 Printer.
A. Turn off power
B. Open paper window
C. Pull bail bar away from platen
D. Push paper release lever toward back of printer
E. Push paper through slot in paper cover and guide it to front of platen
F. Pull paper release lever toward front of printer
G. Push bail bar against platen
H. Close paper window
I. Turn platen knob to reposition paper

18. Go back to Step #16 and answer question "G" by pressing <RETURN> This will send data for the division file to the printer.

19. Printer will print page 1 of the division.

20. When page is complete, remove page from printer, insert blank piece of paper into printer and Type P to continue printing file.
Continue this procedure until all pages of the file are printed. (Refer to Step #12 and #16, Question "C").

21. You now have an unedited version of the assigned division. Refer to ASSIGNMENT sheet for further instructions.

Bibliography:

1. Disco-Specs Software Instruction Manual, by Disco-Tech, a division of Morton Technologies, Inc., Santa Rosa, Calif.

2. Wordstar Software Instruction Manual by MicroPro.

3. Owner's Manual, User's Guide and Starting-Out Manual for the DEC Rainbow 100 Computer, by the Digital Equipment Corporation, 1982.

4. Installing and Using the LA50 Printer, by Digital Equipment Corporation, 1982.

BURLINGTON COUNTY COLLEGE
PEMBERTON , NEW JERSEY

ARCHITECTURAL SPECIFICATIONS ON COMPUTER

DEC RAINBOW 100
WORDSTAR
DISCO-SPECS

PREPARED BY: LARRY DAVID SECHLEER
ARCHITECTURE INSTRUCTOR
MAY 1984

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DIVISION 0

INSTRUCTIONS TO BIDDERS

1.01 GENERAL.

All proposals, in order to be entitled to consideration, must be made in accordance with the following instructions:

1.02 DOCUMENTS.

May be secured at office of Architect.

1.03 EXAMINATION.

Bidders shall carefully examine the documents, visit work site, and fully inform themselves of all existing conditions and limitations.

1.04 QUESTIONS.

Submit all questions concerning drawings and bidding documents to Architect in writing. Replies will be issued to all prime bidders of record as addenda and will become a part of the contract. Neither Owner nor Architect will be responsible for any oral instructions.

1.05 PREPARATION OF PROPOSAL.

Proposals shall be submitted on the unaltered bid form prepared and furnished by Architect, a copy of which is attached hereto. Proposals shall be completed, including each and every item; bids shall be stated both in text and in figures. Proposals shall be signed by Bidder in longhand with Bidder's name typed below the signature. Where Bidder is a corporation, proposals must be signed with the legal name of the corporation followed by the name of the state of incorporation and the legal signature of an officer authorized to bind the corporation to a contract.

1.06 BASIS OF BIDS.

Proposals shall not contain any recapitulation or qualification of the work to be done. Alternate proposals will not be considered unless requested by Owner or Architect. No oral, telegraphic, or telephonic proposals or modifications will be considered.

1.07 SUBSTITUTIONS.

Bidder may offer substitutions for any item noted on the drawings. List the name of the substituted item, the manufacturer, model name or number, etc., together with the amount to be added or deducted from the base bid if the substitution is approved. Owner reserves the right to accept or reject any proposed substitution after fair consideration. No substitutions will be permitted later than fifteen (15) days after contract is awarded.

Products noted on the drawings establish minimum quality standards which substitutes must meet in order to be considered acceptable. Burden of proof of quality rests with Bidder.

1.08 BID SECURITY.

Bid security shall be made payable to Owner, in the amount of ten percent (10 percent) of the proposal sum. Security shall be either certified or cashier's check or bid bond issued by a surety company licensed to conduct business in the State of New Jersey.

1.09 BONDS.

The successful bidder will be required to furnish a labor and materials bond in an amount equal to one hundred percent (100 percent) of the contract price and a performance bond in an amount equal to one hundred percent (100 percent) of the contract price. Said bonds shall be secured from a surety company or surety companies satisfactory to Owner, licensed by the State of New Jersey and shall be filed with Owner prior to execution of the contract.

1.10 SUBCONTRACTORS.

Each bidder shall set forth, on a form provided by the Architect and attached hereto, the name and address of each subcontractor who will perform work or labor or render services to Bidder in or about the work in an amount in excess of one-half (1/2) of one percent (1 percent) of Bidder's total bid. If Bidder fails to specify a subcontractor for any portion of the work to be performed under the contract, he shall be deemed to have agreed to perform that portion of the work himself. The succesful bidder shall not, without the consent of Owner:

(A) Substitute any person as a subcontractor in place of the subcontractor designated in the original bid.

(B) Permit any subcontract to be assigned or transferred, or permit it to be performed by anyone other than the original subcontractor designated.

(C) Sublet or subcontract any portion of the work in excess of one-half (1/2) of one percent (1 percent) of the total bid for which his original bid did not designate a subcontractor.

Owner reserves the right to approve all subcontractors whose services may be used by Contractor in the prosecution of the work. In the event that Owner does not accept a subcontractor, the contract price shall be adjusted by reason of the substitution.

1.11 SUBMITTAL.

Submit proposal and bid security in an opaque, sealed envelope. Identify the envelope with: (1) Project Name, (2) Name of Bidder.

1.12 MODIFICATION AND WITHDRAWAL.

Proposals may not be modified after submittal. Bidders may withdraw proposals at any time before bid opening, but may not resubmit them. No proposal may be withdrawn or modified after the bid opening except where the award of contract has been delayed for thirty (30) days or more.

1.13 FORM OF CONTRACT.

The agreement which the successful bidder, as Contractor, will be required to execute is attached hereto and is made a part hereof.

1.14 TIME FOR COMPLETION.

The time limit established for completion of said work shall be as set forth in the proposal form.

1.15 CHANGE ORDERS.

Change orders are instruments of service used to change the provisions of the contract documents and are the only means by which such change can be made. Change orders are not valid until signed by Owner, Contractor, and Architect.

1.16 AWARD OR REJECTION OF BIDS.

Owner reserves the right to reject any or all bids or to accept irregularities in any bid received. Bidders may be required to submit financial and experience statements after the opening of bids. The competence and responsibility of bidders and of their proposed subcontractors will be considered in making award of the contract.

I have also received Addenda Nos. _____ and have included their provisions in my proposal.

I have visited the site and examined all conditions affecting the work.

In submitting this proposal, I agree:

1. To hold my bid open for thirty (30) days after the bid opening.

2. To accept the provisions of the instructions to bidders _____ regarding dispostion of bid security.

3. To enter into and execute a contract, if awarded on the basis _____ of this proposal.

4. To accomplish the work in accordance with the contract documents.

5. To complete the work within two hundred ten (210) calendar days after signing the contract, excluding extensions of time as approved by the Architect.

6. To furnish the necessary bonds within five (5) days of the date of signing the contract.

7. To furnish upon request of Owner, unit prices for subcontract work. The unit price shall include both labor and material, as well as all related costs required to produce the unit, unless specifically noted otherwise.

BASE BID

I will construct this project, exclusive of the street improvements, site improvements, and interior fixtures, for the lump sum price of: _____Dollars ($_____)

It is mutually agreed and understood that street improvements, site work, and interior fixtures are not a part of this contract. The General Contractor, however, assumes responsibility for coordination of all work.
Should the work not be completed within the time stated above, it is understood and agreed that there will be deducted from the final contract amount the sum of $50.00 per day as liquidated damages, but not as a penalty, for each day's delay after the expiration of the building period and until the final completion of the work and its acceptance the Owner.
Listed below is the name of each subcontractor, including subcontractors involved with the alternates, the price of whose work constitutes one-half (1/2) of one percent (1 percent) of the total bid or more, as described in the instructions to bidders.

The undersigned agrees that in the event that Owner desires the use of subcontractors other than those listed, the contract price shall be adjusted in the amount of the difference between their bids.

SEGREGATED PART OF WORK	SUBCONTRACTOR AND ADDRESS

DATE_____ SIGNED_____

TITLE_____

NAME OF FIRM_____

STATE LICENSE NO._____

LEGAL ADDRESS ORGANIZED AS A: (Mark one)

_____ ____PROPRIETORSHIP

_____ ____PARTNERSHIP

_____ ____CORPORATION

TELEPHONE_____

AGREEMENT FORMS

LUMP SUM BID

THIS AGREEMENT, entered into this _____ day of _____, 1981, by _____ _____, hereinafter called Contractor, and _____ _____, hereinafter called Owner.

WITNESSETH that Contractor and Owner, in consideration of premises and of the mutual covenants, considerations, and agreements herein contained, agree as follows:

STATEMENT OF WORK: Contractor shall furnish all labor, materials, tools, transportation, and equipment necessary for the complete construction of:

(PROJECT TITLE)

In strict accordance with the drawings and bidding documents prepared by _____ _____ _____ for _____ _____ including addenda hereto numbered _____ and all other Contract Documents, Instructions to Bidders, Form of Proposals, General Conditions, and Supplementary General Conditions, all of which are made a part hereof.

COMPENSATIONS TO BE PAID TO CONTRACTOR: Owner will pay and Contractor will accept in full consideration for the performance of this contract, the sum of _____ _____ Dollars ($_____)

Owner shall make payment on account of the contract as follows:

After the contract has been awarded, Contractor shall file with Architect a segregation of his lump sum bid into items according to the various trade subdivisions, the sum of which shall equal the amount of this contract.

On or about the 20th day of each month as the work progresses, there will be presented to the bank an itemized statement showing the total amount expended and/or due for work performed or material or equipment furnished during the preceding monthly period. Such statement shall be approved in writing by Architect and the Borrower; thereafter upon its approval by bank, the bank will disburse 90 percent of the total expended and/or due, less prior disbursements. The final 10 percent will be disbursed after the building is fully completed, Notice of Completion filed of record, and when the title company which issued said policy of title insurance will make an endorsement on said policy insuring against loss by reason of any mechanic's or materialman's lien arising out of said improvement work, provided that there are no unpaid claims on file with the bank against any of said building funds in the hand of the bank.

Payments hereunder may at any time be reduced or withheld by Owner if Contractor is not diligently and efficiently endeavoring to comply with the intent of this contract, or if Contractor shall fail to pay for labor and material used on the project when said payments become due.

Payment for additional work or extras, if any, under this contract, shall become due and payable in full on the date of the acceptance of the completion of the contract as a whole. Ninety percent (90 percent) of such payment will be made on the payment which first follows the completion of said additional work or extras. The value of omissions, if any, from the contract shall be deducted from the amount of the contract price; and the deduction will be made from the payment which first follows the authorization for said deduction.

If after the work has been substantially completed, full completion thereof is materially delayed through no fault of Contractor, Owner shall, without terminating the contract, make payment of the balance due for that portion of the work which has been fully completed and accepted. Such payment shall not constitute a waiver of claims.

When the project is substantially complete Contractor shall prepare a punch list or check list of items to be completed, which shall include any such items as requested by Owner. After such list is completed or corrected, a Notice of Completion will then be filed.
Liquidated damages in the amount of $50.00 per day after the specified contract completion date will be deducted from the final contract amount for non-fulfillment of the contract.

IN WITNESS WHEREOF: The parties hereto on the day and year first above written have executed this agreement.

ATTEST:

_____

CONTRACTOR

_____ _____

BY

_____ _____

ADDRESS BUSINESS ADDRESS

ATTEST:

_____

OWNER

_____ _____

BY

GENERAL CONDITIONS OF THE CONTRACT

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These General Conditions are divided into sections for ease of reference. Any mention of requirements in one section shall apply to any or all sections whether specifically mentioned or not.

GC-01 DEFINITIONS

A. "Approved" shall mean when/as approved in writing by the Architect or Engineer.

B. "As directed" shall mean "as may be directed" and shall simply that the Architect's judgment is required.

C. "As required" shall mean "when/as required" by any applicable regulation, Ordinance, or Code or by the Architect.

D. "Contractor" shall mean the party entering into the Contract for the performance of the work covered by this contract and his duly authorized agents.

E. "Subcontractor" shall mean only those who have a direct contract with Contractor; and it includes one who furnishes labor only or labor and material; but it does not include one who merely furnishes material which is not worked in a special manner.

F. "Project" shall mean the entire improvement proposed by the Owner to be constructed in whole or in part, pursuant to the Contract Documents.

G. "Work" of the Contractor or Subcontractor includes labor or materials, or both, equipment, transportation, or other facilities necessary to complete the contract or that specified part of the contract.

H. "Written Notice" shall be deemed to have been duly served if it is sent by certified mail or delivered in person to the last business address known to him who gives the notice. It shall be addressed or delivered to the individual, to an authorized representative, or to an officer of the corporation for whom it is intended.

GC-02 CONTRACT DOCUMENTS

Consist of the Instruction to Bidders, Proposal, Agreement, General Conditions, Supplementary General Conditions, Drawings and Specifications, including all modifications thereof incorporated into the Documents before their execution. The Agreement takes precedence over all other Contract Documents.

Drawings and specifictions are cooperative. Work or material shown or mentioned in either document shall apply to both. Anything not explicitly shown or mentioned but which is necessary to complete the work is to be supplied and installed. Figures shall prevail over scaled measurements and detail drawings over general drawings.

Contractor shall keep one (1) copy of all Contract Documents, in addition to the stamped set required by the Building Dept., and one (1) copy of all addenda, change orders, and approved shop drawings in good order, available for inspection by Architect, Engineer, Owner and their representatives at all times.

GC-03 ARCHITECT & ENGINEER STATUS

A. The Architect (or his duly authorized agent) shall be Owner's representative. If Owner has not retained Architect for administraton, all reference to Architect shall mean Owner and Architect is not liable for any action, decisions, or interpretations made by Owner.

   Should anything be omitted from the Specifications and Plans which is necessary for a clear understanding of the work, or should it appear that various instructions are in conflict, then Contractor shall secure instructions from Architect or Engineer before proceeding with the construction which is affected by such omissions or discrepancies. It is understood and agreed that the work shall be performed and completed according to the true spirit, meaning, and intent of the Contract.

   Architect shall have authority to stop work if the Contract is not being fulfilled or if work is not being executed in a proper manner.

   Architect shall be impartial to both Owner and Contractor and enforce faithful performance by both.

B. Engineer shall mean the Engineer or Engineers, if any, who have been employed by Owner for this work, or their duly authorized agents, such agents acting severally within the scope of the particular duties entrusted to the Engineer.

C. See 4-A "Access to the Work".

GC-04 OWNER'S RIGHTS & RESPONSIBILITIES

A. ACCESS TO THE WORK: Architect, Engineer, Owner, and their representatives shall have access at all times to the work for purposes of inspection, whenever said work is in preparation or progress; and Contractor shall provide proper facilities for such access and inspection.

B. CHANGE: Owner, without invalidating the Contract, may order Contractor to do additional work or make changes by altering, adding to, or deducting from the work. The Contract Sum will be adjusted accordingly.

C. DO WORK OR TERMINATE CONTRACT: Owner may, after ten (10) days written notice to Contractor, take over completion of the job or terminate Contractor's employment if Contractor fails or refuses to furnish sufficient materials and/or workmen to execute the work properly; if Contractor shall be adjudged bankrupt; if Contractor should make a general assignment for the benefit of his creditor; if a receiver should be appointed on account of Contractor's insolvency; if Contractor should fail to make prompt payments to subcontractors; if Contractor should persistently disregard laws, ordinances, or instructions of Architect; or if Contractor substantially violates any provision of the Contract. If the unpaid balance exceeds cost of completion, including Architect's additional service, such excess shall be paid to Contractor. If expenses exceed the unpaid balance, Contractor shall pay the difference.

D. FILE NOTICE OF COMPLETION: File at the office of the County Recorder the "Notice of Completion" promptly upon the final acceptance of the work covered by this Contract.

E. INSURANCE: Effect and maintain Fire, Extended Coverage, Vandalism, and Malicious Mischief Course of Construction Insurance (Form 74B, Standard Forms Bureau) in an amount satisfactory to Contractor and payable as their interests appear.

F. SEPARATE CONTRACTS: Owner may let other contracts in connection with the work and Contractor shall cooperate properly with any such other contractors.

G. SURVEYS: Owner will establish lot lines, restrictions, and a permanent bench mark. All other grades, lines, and bench marks shall be established and maintained by the Contractor.

H. METER: Owner will pay for water meter and any sewer connection fees, if required, and will pay water bills during construction. Owner will pay assessment for water and sewer based on property acreage or front footage, as well as gas main or service extensions beyond the length installed by utility company.

I. WITHHOLDING PAYMENT: Payments otherwise due may be withheld because of defective work not remedied, liens filed, damage by Contractor to others which have not been adjusted, or Contractor's failure to make payments properly to subcontractors or for material or labor.

GC-05 CONTRACTOR'S RIGHTS & RESPONSIBILITIES

A. ACCESS TO WORK: Contractor shall permit and facilitate observation of the work by Owner and his agents and public authorities at all times.

B. CHANGES AND EXTRA WORK: Contractor shall not perform any extra work or claim remuneration for such work unless written approval which describes the type and amount of extra work or financial credit is given by Owner beforehand. Contractor may be reimbursed for extras as they are completed. No extra remuneration will be allowed for any legally required work which may not be specifically mentioned or shown on the Drawings.

C. CLEAN-UP: Contractor and each subcontractor shall at all times keep the premises free from accumulation of waste material or rubbish caused by his employees or work; and at the completion of work, he shall remove all of his rubbish from and about the building, as well as all of his tools, scaffolding, and surplus materials, and shall leave his work "broom clean" or its equivalent, unless more exactly specified. Necessary precautions shall be taken to prevent dirt and/or dust from becoming a nuisance to the general public. All windows and plumbing fixtures shall be washed clean. In case of failure to comply with this requirement, either Owner or Contractor may remove rubbish and/or effect appropriate clean-up and charge the cost to the several Subcontractors as he shall determine to be just.

D. EXAMINATION OF PREMISES: Contractor shall examine Site before submitting bid, compare the drawings and specifications with any work in place, and inform himself of all conditions, including other work, if any, being performed. Failure to visit Site will in no way relieve the successful Bidder from the necessity of furnishing materials or performing work that may be required to complete work in accordance with drawings and specifications, without additional cost to the Owner.

E. GUARANTEE: Neither the final certificate nor payment nor any provisions in the Contract Document shall relieve Contractor of responsibility for faulty materials or workmanship. Guarantee: Contractor shall be responsible for all work under this contract and shall leave all systems (mechanical, electrical, plumbing, etc.) in perfect operating condition. Contractor shall regulate, replace, and-

/or repair at his own expense any defective workmanship, materials, and/or equipment which may become apparent within one year after date of final acceptance of the work. Owner's decision shall be final with respect to imperfections. Contractor shall provide Owner with manufacturers' written guarantees of materials and equipment.

F. INSURANCE: Contractor shall not commence work under this contract until he has obtained all insurance required under this paragraph, with such insurance having been approved by Owner; nor shall Contractor allow any subcontractor to begin work on his subcontract until appropriate insurance of the subcontractor has been obtained and approved by Owner.

1. Workman's Compensation Insurance: Contractor shall procure and shall maintain during the life of this contract insurance for all of his employees who will be engaged in work on the project under this contract, and in case of any such work sublet, Contractor shall require each subcontractor similarly to provide insurance for all of that subcontractor's employees who will be engaged in such work.
2. Contractor's Public Liability and Property Damage Insurance: Contractor shall procure and shall maintain during the life of this contract Liability Insurance in an amount not less than $300,000.00 for injuries, including accidental death, to any one person, and subject to the same limit for each person, in an amount not less than $300,000.00 on account of one accident, and Property Damage Insurance in an amount not less than $100,000.00.
3. Contractor's Insurance shall cover indemnification as required by GC-05-F of the General Conditions.
4. Subcontractor's Public Liability and Property Damage Insurance: Contractor shall require each of his subcontractors to procure and to maintain, during the life of his subcontract, Subcontractor's insurances of the type specified in Subparagraph (2.) herein in amounts approved by Owner.
5. General Liabilities: Contractor and each subcontractor shall indemnify and save harmless Owner from and against all losses and all claims, demands, payments, suits, actions, recoveries, and judgments of every nature and description brought or recovered against him, by reason of any act or omission of said Contractor, his agent or employees, in the execution of the work or in the guarding of it.
6. Fire Insurance: Each subcontractor shall secure and pay for Fire Insurance and extended coverage completely covering the value of construction at all times until the work is completed and accepted. Failure by Contractor to secure and pay for such Fire Insurance shall give Owner the right to do so and to deduct the cost from the contract amount.

G. LINES AND LEVELS: Contractor shall establish to the job and provide barriers as required.

I. ROYALTIES AND PATENTS: Contractor shall pay all royalties ples as required and perform work in accordance with approved samples.

K. SUBLETTING: Contractor shall be responsible for allocating portions of the work to his subcontractors, if any. sions of the Specifications are not intended to control or limit Contractor in dividing the work among subcontractors therein, as well as a just share of any insurance money received.

L. SUPERVISION: Contractor shall maintain at all times a competent foreman to provide efficient supervision and to complete the job without undue delay.

M. CLEAN-UP: Subcontractor shall remove all rubbish, debris, and excess materials resulting from operations and leave work ready for next trade.

N. GUARANTEE: Subcontractor shall submit to Owner a one (1) year guarantee in writing if requested by Owner. Guarantee applies whether Owner requests it or not.

O. INSPECTION: Each Subcontractor shall inspect all areas or surfaces adjacent to, covered by, or affecting his work.
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until such defects or conditions have been corrected. Starting work will be considered to be an acceptance of the work of others.

P. INSURANCE: Maintain insurance and protect Owner per GC-05-F.

GC-07 PERMITS, LICENSES & REGULATIONS

A. INSPECTION AND PERMIT: Contractor shall obtain and pay for all permits, licenses, and inspections as required, give all notices, pay all fees, and comply in every respect with the Laws, Ordinances, Rules, and Regulations which apply to the job. If Owner has obtained and paid for the Plan Check or Permit, Contractor shall credit Owner for those Building Department fees which Owner advanced.

B. LAWS AND ORDINANCES: Contractor shall comply with all Rulings and Requirements of all authorities which have jurisdiction over this property and protect Owner from damages which arise from violation thereof. If requirements of Contract Documents are at variance with Laws, Ordinances, Regulations or Codes, Contractor should not proceed with work, except at his own risk, until Architect clarifies discrepancy.

C. MANUFACTURER'S DIRECTIONS: All articles, materials and

equipment shall be installed, applied, connected, used, cleaned, and conditioned as directed by the manufacturer, except where otherwise specified.

D. TRADE ASSOCIATION SPECIFICATIONS & RECOMMENDATIONS: Wherever reference is made in these specifications to Trade Association Specifications or Recommendations, those Specifications or Recommendations, or their most recent revision, shall become a part of these Specifications and their instructions shall be complied with in their entirety, as they apply to this particular job, except where otherwise specified.

GC-08 MATERIAL & WORKMANSHIP

A. CASH ALLOWANCES: Contractor shall include in the Contract Sum all allowances named in these Specifications. No demands for expenses or profits other than those included in the Contract Sum shall be allowed. Where a specified amount of money is allowed for any work or material, such as hardware, etc., Owner will be permitted to select and obtain same where he chooses and will have the benefit of any deduction from the allowance.

B. CUTTING AND PATCHING: Each Subcontractor shall do all cutting, fitting, and patching of his work which may be required to make its several parts come together properly and which will receive or be received by work of other contractors. Contractors shall not endanger any work by cutting, digging, or any other way, and shall not cut or alter work of any subcontractor without the consent of Architect or Engineer.

C. QUALITY, MATERIAL, AND WORKMANSHIP: It is intended that a high standard of workmanship shall apply throughout. All work shall be plumb, level, uniformly-sloped, and evenly-spaced, as individually required. All millwork and casework shall be free of hammer marks, nicks, and splits; and joints shall be hairline. All masonry shall be evenly-jointed, properly-coursed, and bonded. All floor materials shall have neat and inconspicuous joints. All equipment shall be cleaned and lubricated. All work shall be protected from damage or deterioration of any kind. The foregoing applies to every division of the work and will not be repeated in every sub-division of the Specifications. Unless otherwise specified, all materials shall be new.

D. REMOVAL OF IMPROPER WORK: Remove all improper work after it has been classed as such by agreement or arbitration. Any cost caused by defective or ill-timed work shall be borne by the responsible party.

E. SCOPE OF WORK: These General Conditions shall apply to each Contractor and Subcontractor. Mention herein of materials, articles, operations, and methods applicable to the contract work requires that Contractor provide each item mentioned or indicated of acceptable quality and

subject to qualifications specified. Contractor shall perform according to conditions stated for each operation prescribed and provide all necessary labor, materials, equipment, and incidentals (including but not limited to temporary toilets, light power, tools, scaffolding, temporary barricades, and transportation).

F. SUBSTITUTIONS: Materials and equipment, including specifically-designated makes, must be furnished as specified, except when equals are approved in writing by Architect. Allow adequate time for Architect to evaluate proposed substitutions.

G. TITLE TO MATERIAL: No materials or supplies for the work shall be purchased by Contractor or any Subcontractor subject to any chattel mortgage or under a conditional sale or other agreement by which an interest is retained by the Seller of such materials or supplies.

GC-09 LEGAL REQUIREMENTS

A. ARBITRATION: Any disagreement arising out of this contract or from the breach thereof shall be submitted to arbitration. Such arbitration shall be conducted in accordance with the Rules of the American Arbitration Association insofar as the same are not in conflict with the Laws of the State.

B. ASSIGNMENT: Neither party to any of the contracts required hereunder shall assign the contract or sublet it as a whole without written consent of the other party, nor shall Contractor or any subcontractors assign any money due to him or to become due to him hereunder, without the previous written consent of Owner.

C. DAMAGES: Contractor and each subcontractor shall be liable for:

(1) Any damage that may be done to this or adjoining property.
(2) All accidents due to or by reason of negligence on the part of his employees, laborers, servants, subcontractors, or strangers arising from his work.

(3) Contractor agrees that he will sustain all losses or damages arising from the action of the elements, the nature of the work to be done under these specifications, or from any unforeseen obstructions or encumbrances on the line of the work which may be encountered in the prosecution of the work, until the work is finally accepted.

END OF SECTION

DIVISION 1

GENERAL REQUIREMENTS

SUMMARY OF WORK

1.01 PERMITS.

A. Obtain general building permit and any permits required for various trades.

1.02 MEASUREMENTS.

A. Verify measurements at site and assume responsibility for accuracy of measurements.

1.03 OBSTRUCTIONS.

A. Remove obstructions as necessary for proper reception, performance, construction, installation, and completion of work specified herein.

1.04 RESTORATION.

A. After completion of all other work, repair portions of site which have been damaged because of building operations specified herein.

1.05 RECORDS.

A. Keep at job site a neat, complete, and accurate record of all approved deviations from contract drawings, shop drawings, and specifications, indicating work as actually installed. Record changes on prints of drawings affected.

COORDINATION

1.01 COOPERATION.

A. Give work the constant attention necessary to facilitate its progress. Cooperate with Architect. Maintain at Site a competent and reliable representative authorized to receive orders and to initiate necessary actions.

1.02 COORDINATION.

A. Be responsible for proper fitting and coordination of operations of various subcontractors, trades, and materialmen.

1.03 USE OF STRUCTURE.

A. Owner shall have right at any time during construction of structure to enter same for the purpose of installing work covered under a different contract. Contractor and Owner will, so far as possible, work to the mutual advantage of both, where their several works touch upon or interfere with each other.

1.04 CUTTING AND PATCHING.

A. Cut, patch and refinish work as necessary to coordinate its several parts, so that it functions optimally, and as indicated in, or reasonably implied by, plans and specifications.

1.05 DIVISION OF SPECIFICATIONS.

A. These specifications are arranged in several sections and indexed for ease of reference. Such arrangement shall not be considered, however, to define or limit the work of any particular subcontractor, trade, or craft.

1.06 TEMPORARY SUSPENSION OF WORK.

A. Architect or Engineer shall have authority to suspend the work wholly or in part for such periods as they may deem necessary, due to unsuitable weather or other conditions considered unfavorable for suitable prosecution of work, or because of failure of Contractor to perform any provisions of contract. Immediately suspend work, in whole or in part, upon receipt of a written order from Architect or Engineer. Resume work as ordered by Architect or Engineer. Do not suspend work without written authority of Architect or Engineer.

SUBMITTALS

1.01 GENERAL.

A. Submittals hereinafter required shall be made to Architect as follows, unless otherwise specified:

1. Written submittals: Typed, 6 copies;

2. Drawings: Prints, 3 copies;

3. Catalog cuts: Original and 5 copies.

1.02 PROGRESS SCHEDULE.

A. Progress schedule shall show proposed dates of start and completion of each subdivision of work.

1.03 COST SCHEDULE.

A. Cost schedule shall show detailed breakdown of costs. Sum of all items shall equal contract price.

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

1.01 TEMPORARY UTILITIES.

A. Furnish electricity and water for all work specified herein. Ascertain locations for temporary service sources and make connections.

1.02 SANITARY FACILITIES.

A. Provide sanitary facilities for duration of project.

1.03 SCAFFOLDING.

A. Furnish and install scaffolding required for work specified herein.

1.04 BARRICADES.

A. Erect, install, and maintain all temporary public walks, warning signs, barricades, and other protective means as may be ordered by Architect for protection of the public from injury.

1.05 SECURITY.

A. Care of work specified herein shall be the responsibility of Contractor during the progress of and until completion of and acceptance of the entire work. This requirement shall cease to apply to any portion of the work when such is completed and accepted before end of the contract.

1.06 DEBRIS CONTROL.

A. Remove debris, empty crates, waste, etc. from building and site at the end of each day's work and leave grounds clean and orderly. Keep driveways, entrances, and walks clean and clear at all times.

MATERIAL AND EQUIPMENT

1.01 NUMBER OF ITEMS REQUIRED.

A. Whenever an article, device, or piece of equipment specified herein is referred to in the singular number, such reference shall apply to as many such articles as are indicated on Drawings or required to complete the installation.

1.02 SUBSTITUTIONS.

A. Substitutions of material and equipment will not be allowed after the bid date except when dictated by unforeseen circumstances such as:

1. If a specified or prequalified item is delayed by a lengthy strike at the factory, shipment, or elsewhere, causing extensive delay in project completion, a substitute item will be considered by Architect.

2. If a specified or prequalified item proves to be unusable because of changed or other circumstances, a substitution will be considered by Architect. The requested substitution will need to be justified fully in writing by the Contractor, including competitive quotations, etc., and any cost savings will be rebated to Owner. A written statement showing unit price and quantities involved shall be submitted to Architect, together with other information justifying the substitution.
The above shall not be construed to mean that substitution of materials and equipment will be allowed routinely. Owner reserves the right to disapprove and reject any request he deems irregular.

CONTRACT CLOSEOUT

1.01 CLEANING.

A. Clean all interior and exterior building surfaces and make same ready for use, before final inspection and after completion of all building construction operations. Wash and rinse floors. Wash and polish both sides of window glass and remove labels. Wash fixtures and polish trim. Restore, or replace, all damage or defaced surfaces to original condition.

1.02 PROJECT RECORD DOCUMENTS.

A. Submit one copy of the following to Architect upon completion of work:

1. Notarized statement certifying payment of all bills.

2. Name, address, and telephone number of Contractor and major subcontractors and suppliers.

3. Guarantees, warranties, and bonds as required and as furnished by subcontractors and suppliers.

4. Releases of lien covering all labor and materials.

5. Instructions and information on the maintenance and/or operation of equipment and finishes.

1.03 AS-BUILT DRAWINGS.

A. Submit two copies of drawings with changes made according to requirements of SECTION 01010, ARTICLE 1.05 of these specifications, upon completion of work.

1.04 NOTICE OF COMPLETION.

A. When advised by Architect, arrange for publication of a Notice of Completion in a local newspaper. Notice shall appear twice, with a seven-day interval between dates of publication. File a copy of newspaper notice with Clerk of the Court of the appropriate County.

1.05 CERTIFICATE OF OCCUPANCY.

A. Prepare and file a request for Certificate of Occupancy with Building Department and deliver a copy of Certificate to Architect.

DIVISION 2

SITE WORK

SITE GRADING

PART 1 - GENERAL

1.01 SCOPE.

A. Work included: Excavate, backfill, compact, and grade site to elevations shown on Contract Drawings, as specified herein, and as needed to meet requirements of construction shown.

B. Related work described elsewhere:

1. STRUCTURE EXCAVATION AND BACKFILLING -- SECTION 02220

2. ASPHALTIC CONCRETE PAVING -- SECTION 02513

1.02 QUALITY ASSURANCE.

A. Perform work of this Section in strict accordance with applicable requirements of governmental agencies which have jurisdiction and under direction of Soils Engineer.

B. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in necessary crafts and who are completely familiar with the specified requirements and methods needed for proper performance of work specified in this Section.

C. Use equipment adequate in size, capacity, and numbers to accomplish work in a timely manner.

1.03 JOB CONDITIONS.

A. Utilities:

1. Before starting work, coordinate work and obtain clearance from utility companies and/or governmental agencies which supply existing or proposed services to project.
2. Unless they are shown to be removed, protect active utility lines shown on Drawings or otherwise made known to Contractor prior to excavating. If damaged, repair or replace such utility lines at no additional cost to Owner.

3. If active utility lines are encountered and are not shown on the Drawings or otherwise made known to Contractor, take necessary steps promptly to assure that service will not be interrupted.

4. If service is interrupted by work performed under this Section, immediately restore service by repairing damaged utility at no additional cost to Owner.

5. If existing utilities interfere with permanent facilities being constructed under this Contract, immediately notify Architect and obtain instructions from him.

6. Do not proceed with permanent relocation of utilities until you receive written instructions from Architect.

B. Protection of persons and property:

1. Barricade open depressions and holes which occur in the performance of this work. Post warning lights on property adjacent to, or with public access to, the work site.

2. Operate warning lights during hours from dusk to dawn each day and as otherwise required.

3. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by operations under this Section.

C. De-watering:

1. Remove all water, including rain water, encountered during trench and sub-structure work to an approved location by pumps, drains, and other approved methods.

2. Keep excavations and site construction area free from water.

D. Dust control:

1. Control dust on and near work, and on and near off-site areas, if such dust is caused by Contractor's operations during performance of work or if dust results from condition in which Contractor leaves site.

2. Thoroughly moisten surfaces as necessary to prevent dust from being a nuisance to neighbors, general public, and personnel performing work on site.

E. Maintain access to adjacent areas at all times.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS.

A. Fill and backfill materials:

1. Provide soil materials free from organic matter and deleterious substances, which contain no rocks or lumps more than 6" in greatest dimension. Not more than 15% of rocks or lumps shall be larger than 2-3/8" in greatest dimension.

2. Fill material is subject to approval of Soils Engineer. Fill material is that material removed from excavations or imported from off-site borrow areas. It shall be predominantly granular, non-expansive soil, free from roots and other deleterious matter.

3. Do not allow inclusion of rocks which have a dimension greater than 1" in the upper 12" of fill or embankment.

4. Cohesionless material used for structural backfill: Use sand which is free from organic material and other foreign matter, as approved by Soils Engineer.

2.02 WEED KILLER.

A. Provide a dry, free-flowing, dust-free chemical compound, soluble in water, capable of inhibiting vegetation growth, and approved for use in this Work by governmental agencies which have jurisdiction in such matters.

PART 3 - EXECUTION

3.01 INSPECTION.

A. Examine areas and conditions under which work of this Section is performed. Correct conditions which are detrimental to timely and proper completion of work before proceeding with work.

3.02 FINISH ELEVATIONS AND LINES.

A. Secure services of a registered civil engineer or licensed land surveyor to set and establish finish elevations and lines.

B. Carefully preserve all data and monuments set by Civil Engineer or Land Surveyor. If displaced or lost, have them replaced immediately at no additional cost to Owner.

3.03 EXCAVATING.

A. Excavate every type of material encountered within limits of Work to lines, grades, and elevations indicated and as specified herein.

B. Excavated materials satisfactory for fill: Transport to, and place in, fill or embankment areas within limits of Work.

C. Excavated materials unsatisfactory for fill:

1. Excavate to a distance below grade as directed by Soils Engineer and replace with satisfactory materials.

2. Include excavation of unsatisfactory fill materials and replacement with satisfactory fill materials as parts of work of this Section.

3. Dispose of excavated material which is unsatisfactory for fill away from Site at disposal sites arranged and paid for by Contractor.

D. Excavation of rock:

1. Where rocks, boulders, granite, or similar material is encountered, and where such material cannot be removed or excavated by conventional earth-moving or ripping equipment, take necessary steps to proceed with general grading operations of Work. Remove or excavate such material by means which will neither cause additional cost to Owner nor endanger buildings or structures, on or off job site.

2. Do not use explosives.

E. Excavate and backfill in a manner and sequence which will provide proper drainage at all times.

F. Ditches and gutters:

1. Cut accurately to cross sections, grades, and elevations shown.

2. Maintain excavations free from detrimental quantities of leaves, sticks, trash, and other debris, until completion of Work.

3. Dispose of excavated materials as shown on drawings or as directed by Soils Engineer.

G. Unauthorized excavation:

1. Unauthorized excavation is defined here as removal of materials beyond indicated subgrade elevations or dimensions without specific direction of Architect or Soils Engineer.

2. Under footings, foundation bases, or retaining walls: Fill unauthorized excavation by extending indicated bottom elevation of footing or base to excavation bottom, without altering required top elevation.

3. Backfill and compact unauthorized excavations elsewhere, as specified for authorized excavations, unless otherwise directed by Soils Engineer.

H. Stability of excavations:

1. Slope sides of excavations to 1:1 or flatter, unless otherwise directed by Soils Engineer.

2. Shore and brace where sloping is not possible because of space restrictions or stability of materials being excavated.

3. Maintain sides and slopes of excavations in a safe condition until backfilling has been completed.

I. Shoring and bracing:

1. Provide materials for shoring and bracing, as necessary for safety of personnel, protection of work, and compliance with requirements of governmental agencies which have jurisdiction.

2. Maintain shoring and bracing in excavations, regardless of time period that excavations will be open.

3. Carry shoring and bracing downward as excavation progresses.

3.04 FILLING AND BACKFILLING.

A. Backfill excavations as promptly as progress of Work permits, but not until:

1. Acceptance of construction below finish grade;

2. Inspection, testing, approval, and recording locations of underground utilities;

3. Removal of concrete formwork;

4. Removal of shoring and bracing and backfilling voids with satisfactory materials;
5. Removal of trash and debris; and

6. Horizontal bracing is in place on horizontally-supported walls.

B. Ground surface preparation:

1. Remove vegetation, debris, unsatisfatory soil materials, obstructions, and deleterious materials from ground surface before placing fills.

2. Plow, strip, or break up surfaces which are steeper

than one vertical to four horizontal, so that fill material will bond with existing surface or as directed by Soils Engineer.

3. When existing ground surface has a density less than that specified under "3.06 COMPACTING" for a particular area, break up ground surface, pulverize, moisture-condition to optimum moisture content, and compact to required depth and percentage of maximum density.

4. Scarify exposed soils in areas to be paved to a minimum depth of 6" and recompact at a moisture content which will permit proper compaction as specified for fill.

C. Placing and compacting:

1. Place backfill and fill materials in layers which are not more than 8" in loose depth.

2. Before compacting, moisten or aerate each layer as necessary to provide optimum moisture content.

3. Compact each layer to required percentage of maximum density of the area.

4. Do not place backfill or fill material on surfaces which are muddy, frozen, or which contain frost or ice.

5. Place backfill and fill materials to required elevations, evenly adjacent to structures.

6. Take care to prevent wedging action of backfill against structures. Carry material uniformly around structure to approximate same elevation in each lift.

3.05 GRADING.

A. General:

1. Grade areas uniformly within limits of grading under this Section, including adjacent transition areas.
2. Smooth finished surfaces within specified tolerances.
3. Compact with uniform levels or slopes between points where elevations are shown on Drawings, or between such points and existing grades.
4. Where a change of slope is indicated on Drawings, construct a rolled transition section which has a minimum radius of approximately 8'-0", unless adjacent construction will not permit such a transition, or if such a transition defeats positive control of drainage.

B. Grading Tolerances:

1. Grade areas adjacent to buildings to achieve drainage away from structures and to prevent ponding.

2. Finish surfaces to be free from irregular surface changes and:

(a) Walks: Shape surface of areas scheduled to be under walks to line, grade, and cross-section. Finished surface shall not be more than 0.10-foot above or below required subgrade elevation.

(b) Pavements: Shape surface of areas scheduled to be under pavement to line, grade, and cross-section. Finished surface shall not be more than 0.05-foot above or below required subgrade elevation.

(c) Landscape areas: Shape surface of areas scheduled to be landscaped to line, grade, and cross-section. Finished surface shall not be more than 0.10 foot above or below required subgrade elevation.

(d) Structures: Shape surface of areas scheduled to be beneath structures to line and grade. Finished surface shall not be more than 0.05 foot above or below required subgrade elevation.

3.06 COMPACTING.

A. Provide not less than the following maximum density of soil material compacted at optimum moisture content for actual density of each layer of soil material in place, and as approved by Soils Engineer:

1. Structures: Compact the top 8" of subgrade and each layer of fill material or backfill material at 90% of maximum density;

2. Lawn and unpaved areas:

(a) Compact the top 8" of subgrade and each layer of fill material or backfill material at 90% of maximum density;

(b) Compact the upper 12" of filled areas, or natural soils exposed by excavating, at 85% of maximum density;

3. Walks: Compact the top 8" of subgrade and each layer of fill material or backfill material at 90% of maximum density;

4. Pavements: Compact the top 8" of subgrade and each layer of fill material or backfill material at 95% of maximum density for cohesive soil material.

B. Moisture control:

1. Where subgrade or layer of soil material must be moisture-conditioned before compacting, apply water uniformly to surface of subgrade or layer of soil material to prevent free water from apppearing on surface during or after compacting operations.

2. Remove and replace, or scarify and air-dry, soil material that is too wet to permit compacting to specified density.

3. Soil material which has been removed because it is too wet to permit compacting may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing, or pulverizing, until moisture-density relation tests have been approved by Soils Engineer.

3.07 FIELD QUALITY CONTROL.

A. Obtain Soils Engineer's inspection and approval of subgrades and fill layers before permitting subsequent construction thereon.

B. Provide at least the following tests:

1. At paved areas: at least one field density test for each 2000 sq. ft. of paved area; but not less than three tests;

2. In each compacted fill layer: one field density test for each 2000 sq. ft. of overlaying paved area; but not less than three tests.

C. If, in Soils Engineer's opinion, based on reports of Testing Laboratory, subgrade or fills which have been placed are below specified density, additional compacting and testing shall be performed, as required, at no additional expense to Owner.

3.08 MAINTENANCE.

A. Protection of newly-graded areas:

1. Protect newly-graded areas from traffic and erosion and keep free from trash and weeds.

2. Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.

B. Reconditioning compacted areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape, and compact to required density, prior to further construction.

3.09 CERTIFICATION.

A. Upon completion of this portion of Work, and as a condition of its acceptance, deliver to Architect a written report from Soils Engineer certifying that compaction requirements have been met. State in report: area of fill or embankment; compaction density obtained; and type or classification of fill material placed.

B. Upon completion of this portion of Work, and as a condition of its acceptance, deliver to Architect a written report from Civil Engineer or Land Surveyor certifying that finished surfaces are within grade tolerances as specified under "3.05 B Grading Tolerances".

STRUCTURE EXCAVATION AND BACKFILLING

PART 1 - GENERAL

1.01 SCOPE.

Furnish materials and equipment and perform labor necessary to execute work indicated on drawings, specified herein, and necessary to complete work of this Section, including, but not limited to, the following principal items:

A. All required excavation, backfilling, and finish grading within the building area, including five feet beyond periphery of building.

B. Final finish grading for aggregate base material.

C. Miscellaneous related work.

1.02 RELATED WORK SPECIFIED ELSEWHERE.

A. SITE GRADING -- SECTION 02210

1.03 DUST CONTROL.

A. During all foundation operations, water shall be applied to surfaces in working area at frequent intervals and in sufficient quantity to lay dust and for proper compaction.

1.04 CRIBBING AND SHORING.

A. Provide cribbing, sheathing, and shoring necessary to retain earth banks safely and protect excavations and adjoining grades from caving and other damage resulting from excavating. Provide appropriate protection against bodily injury to personnel employed on Work. Responsibility for design, installation, and maintenance of required cribbing and shoring shall be entirely that of Contractor.

PART 2 - PRODUCTS

2.01 QUALITY CONTROL.

A. Compaction test (when required) will be performed by Soils Engineer and paid for by Contractor.

B. Soils at design foundation level shall provide satisfactory support. Footings shall be free of loose soil and shall be approved by Architect and Soils Engineer prior to pouring.

C. Refer to Article 3.04 "SOIL INVESTIGATION REPORT AND SOIL FOUNDATION ENGINEERS."

PART 3 - EXECUTION

3.01 VERIFICATION OF EXISTING CONDITIONS.

A. Visit Site to determine existing conditions, nature of materials to be encountered, and all other facts which concern or affect work. Information on Drawings which pertains to soil conditions and soil investigation report does NOT constitute a guarantee of uniformity of soil conditions throughout Construction Site, NOR a guarantee of ground water levels.

3.02 EXCAVATION.

A. Perform excavation to dimensions and elevations indicated on Drawings or required for footings, and all work incidental thereto. Excavation shall extend a sufficient distance from footings to allow for forming and inspection, except for spread footings where concrete may be deposited directly against earth surfaces, when approved by Architect and governing authorities.

B. Excess excavation shall be avoided. Should an excavation, through error, be cut to greater depth than required, such additional depth shall be filled with concrete of the type and strength used in construction adjacent to or bearing on the excavated surface, at no additional cost to Owner.

C. All excavated material not suitable for filling, backfilling as approved by Architect, and all excess earth or other material shall be removed from Site.

3.03 FILL AND BACKFILL.

A. After completion of footings and other construction below elevation of finish grades, all forms shall be removed and the excavation shall be cleaned of all trash and debris prior to filling and backfilling. No fill or backfill shall be placed until written approval is given by Architect and approved by local building department.

B. Material for filling and backfilling shall consist of excavated material and/or approved imported borrow. It shall be free of organic matter, trash, lumber, or other debris.

C. Refer to soil investigation report of record for fill and backfill compaction requirements.

3.04 CLEAN-UP.

A. Upon completion of work, remove from Site all rubbish, trash, and debris resulting from operations. Remove all equipment and implements of service; and leave entire area in neat, clean, and acceptable condition.

ASPHALTIC CONCRETE PAVING

PART 1 - GENERAL

1.01 SCOPE.

A. Work included: Asphalt concrete paving required for this work includes, but is not necessarily limited to:

1. Aggregate subbase;
2. Aggregate base;
3. Asphalt concrete paving;
4. Seal coat.

B. Related work described elsewhere:

1. SITE GRADING -- SECTION 02210
2. PAVEMENT MARKING -- SECTION 02577

1.02 SUBMITTALS.

A. Product data: Within 35 calendar days after award of Contract, submit certificates, signed by materials producers and asphalt paving subcontractor, which state that materials meet or exceed specified requirements.

1.03 JOB CONDITIONS.

A. Protect materials of this Section before, during, and after installation; and protect work and materials of other trades.

B. In the event of damage, immediately make repairs and replacements to meet approval of Architect and at no additional cost to Owner.

PART 2 - PRODUCTS

2.01 AGGREGATES.

A. Provide aggregates of crushed stone, gravel, sand, or other sound, durable mineral materials, processed and blended.

B. Where subbase is necessary, provide aggregate 1-1/2" maximum size.

C. For base course aggregates, provide following maximum sizes:

1. Base courses more than 6" thick: 1-1/2";

2. Other base courses: 3/4".

D. Aggregates for asphalt concrete paving: Provide a mixture of sand, mineral aggregate, and liquid asphalt mixed in such proportions that the percentage by weight will be within:

Sieve sizes:	Percentage passing:
1/2"	100%
3/8"	67-85%
1/4"	50-65%
No. 8 mesh	37-50%
No. 30 mesh	15-25%
No. 200 mesh	3-8%

plus 50/60-penetration liquid asphalt at 5% to 6-1/2% of the combined dry aggregates.

2.02 WEED KILLERS.

A. Provide a dry, free-flowing, dust-free chemical compound, soluble in water, capable of inhibiting vegetation growth and approved for use on this Work by governmental agencies which have jurisdiction.

2.03 ASPHALTS.

A. Comply with provisions of Asphalt Institute Specification SS-2:

1. Asphalt cement: Penetration Grade 50/60.

2. Prime coat: Cut-back type, Grade MC-250.

3. Tack coat: Uniformly emulsified, Grade SS-1H.

2.04 SEALER.

A. Provide a sealer which consists of suitable fibrated chemical type asphalt base binders and fillers which have a container consistency which is suitable for troweling after thorough stirring and which contains no clay or other deleterious substances.

B. Acceptable products:

1. "Guardtop 11", manufactured by Industrial Asphalt Co., Bell Gardens, California 90201.
2. "Laycold Walktop", manufactured by Chevron Asphalt Co., San Pedro, California.

2.05 MIXING ASPHALT CONCRETE MATERIALS.

A. Provide hot, plant-mixed, asphalt concrete paving materials.

1. Temperature leaving plant: 290 degrees F. minimum; 320 degrees F. maximum.

2. Temperature at time of placing: 280 degrees F. minimum.

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS.

A. Examine areas and conditions under which work of this Section will be performed. Correct conditions which are detrimental to timely and proper completion of Work. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 FINAL PREPARATION OF SUBGRADE.

A. After preparation of subgrade, thoroughly scarify and sprinkle entire area to be paved; then compact to a smooth, hard, even surface of 90% compaction to receive aggregates.

B. Apply specified weed killer to entire area to be paved.

1. Observe manufacturer's application recommendations.

2. Apply under observation of Soils Engineer.

C. Obtain and deliver to Architect a signed report from Soils Engineer stating his approval of preparation of subgrade and application of specified weed killer.

3.03 PLACEMENT OF BASE COURSES.

A. Subbase:

1. Spread specified subbase material to a thickness which meets the compacted thickness shown on Drawings.

2. Compact to 95% of maximum density.

B. Base:

1. Spread specified base material to a thickness which meets the compacted thickness shown on Drawings.
2. Compact to 95% of maximum density.

C. Tolerances:

1. Provide compacted thicknesses shown on Drawings within a tolerance of minus 0.0" to plus 0.5".

2. Provide lines and grades shown on Drawings within 3/8" in 10'-0".

3. Where deviations occur, correct them by removing materials, replacing with new materials, and reworking and recompacting as required.

D. Use only the amount of moisture needed to achieve specified degree of compaction.

E. Secure and deliver to Architect a signed report from Soils Engineer which approves placement of base courses.

3.04 PLACEMENT OF ASPHALT CONCRETE PAVING.

A. Remove all loose materials from compacted base.

B. Apply all specified prime-coat (and tack-coat where required) and allow to dry, in accordance with manufacturer's recommendations.

C. Adjust frames and covers, if necessary, to meet final grades.

D. Receipt of asphalt concrete materials:

1. Do not accept material unless it is covered with a tarpaulin until unloaded, and unless material has a temperature of not less than 280 degrees F.

2. Do not begin placement of asphalt concrete materials when atmospheric temperature is below 50 degrees F., nor during fog, rain, or other unsuitable conditions.

E. Spreading:

1. Spread materials in a manner which requires least handling.

2. Where thickness of finished paving will be 3" or less, spread in one layer.

F. Rolling:

1. After material has been spread to proper depth, roll until surface is hard, smooth, unyielding, and true to thickness and elevations shown on Drawings.

2. Roll in at least two directions until no roller marks are visible.

3. Provide finished paving free from birdbaths and with no deviations greater than 1/8" in 6'-0".

3.05 FLOOD TEST.

A. Before application of seal coat, perform a flood test in the presence of a representative from Architect's office.

B. Method:

1. Flood entire asphalt concrete paved area with water by use of a tank truck or hoses.

2. If a depression is found where water ponds to a depth of more than 1/8", fill or otherwise correct to provide proper drainage.

3. Feather and smooth edges to fill so that joint between fill and original surface is invisible.

3.06 APPLICATION OF SEAL COAT.

A. Prepare surfaces, mix seal coat material, and apply in strict accordance with manufacturer's recommendations.

B. Apply one coat of specified material.

C. Achieve a finished surface seal which, when dry and thoroughly set, is smooth, tough, resilient, of uniform black color, and free from coarse-textured areas, lap marks, ridges, and other surface irregularities.

3.07 PROTECTION.

A. Protect asphalt-paved areas from traffic until sealer is set and cured and does not pick up under foot or wheeled traffic.

PAVEMENT MARKING

PART 1 - GENERAL

1.01 SCOPE.

A. Work included: Provide pavement marking and bumpers, in place, as shown on Drawings, specified herein, and needed for complete and proper installation.

B. Related work described elsewhere:

1. ASPHALTIC CONCRETE PAVING -- SECTION 02513

1.02 QUALITY ASSURANCE.

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in necessary crafts and who are completely familiar with specified requirements and methods needed for proper performance of this portion of Work.

B. In the event of damage, immediately make repairs and replacements to meet approval of Architect, at no additional cost to Owner.

PART 2 - PRODUCTS

2.01 MARKING PAINT.

A. Provide traffic paint as indicated on Drawings

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and conditions under which work of this Section will be installed. Correct conditions detrimental to timely and proper completion of Work. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 PAVEMENT MARKING.

A. Carefully lay out markings in strict accordance with arrangements shown on Drawings.

3.03 PIPE BUMPERS.

A. Where pipe bumpers are shown on Drawings, provide two coats of Highway Yellow to pipe bumpers.

3.04 CONCRETE BUMPERS.

A. Install specified concrete bumpers as shown on Drawings, driving specified anchor pins 2'-0" minimum into paving and earth.

DIVISION 3

CONCRETE

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 REFERENCE STANDARDS.

A. ACI: American Concrete Institute, Manual of Practice.

B. CRSI: Concrete Reinforcing Steel Institute, Manual of Standard Practice.

C. ASTM: American Society for Testing and Materials.

1.02 RELATED WORK SPECIFIED ELSEWHERE.

A. CONCRETE UNIT MASONRY -- SECTION 04220: Embedded items.

B. STRUCTURAL STEEL -- SECTION 05120

C. METAL FABRICATIONS -- SECTION 05500

D. PAINTING -- SECTION 09900

E. METAL BUILDING SYSTEMS -- SECTION 13122

PART 2 - PRODUCTS

2.01 MATERIALS.

A. Form materials for exposed finish concrete: sawn lumber, plywood, metal, or other acceptable panel-type material for producing continuous smooth surfaces. Use largest practicable sizes to minimize number of joints and to conform with joint system shown on drawings. Use sufficient thickness to withstand pressure of wet concrete without deflection.

B. Steel Reinforcement:

1. Reinforcing bars: ASTM A-615, grade 60.
2. Stirrups and ties: ASTM A-615, grade 40.
3. Welded wire fabric reinforcement: ASTM A-185.
4. Accessories: conform with CRSI manual. Accessories exposed in finished surface shall be galvanized.

C. Concrete Materials:

1. Portland cement: ASTM C-150, Type I.
2. Aggregates: ASTM C-33 and the following:
   (a) Fine aggregate: clean, sharp, natural sand, free from loam, clay, lumps.

3. Water: Clean, free from oil, acid, alkali, injurious amounts of vegetable matter, and other impurities; potable.

4. Admixtures: ASTM C-494 or ASTM C-260. Mix in accordance with manufacturer's directions.

2.02 MIXES.

Concrete mixes: ACI 318, 614, and 304, ready-mixed or job-mixed to obtain 3000-psi, 28-day compressive strength; slump not to exceed 4".

2.03 FABRICATIONS.

Shop-fabricated reinforcing: ACI 318, Section .5.

PART 3 - EXECUTION

3.01 REINFORCEMENT AND EMBEDDED ITEMS.

A. Preparation. Clean reinforcement of loose rust, mill scale, and other materials which reduce or destroy bond with concrete.

B. Placement: CRSI Manual

C. Embedded items: set anchorage devices and other items into the work whi are required for work specified elsewhere. Use setting drawings and instructions provided by suppliers of items to be attached thereto.

3.02 CONCRETE PLACEMENT.

A. Notify Architect 48 hours before placing concrete.

B. Place concrete in compliance with ACI 614 and as herein specified. Deposit continuously or in layers of such thickness that no concrete will be placed on hardened concrete in a manner to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified below. Deposit concrete near to or in its final location to avoid segregation caused by rehandling or flowing. Deposit floor slab concrete between screeds at finished level. Set screeds to insure maximum slab thickness, allowing 1/8" shrinkage Screed with straight-edge and leave no hollows or pockets in surface. Obtain a tolerance after curing of no more than 1/8" in 10'.

3.03 FINISHING OF SLABS.

A. Floors which have an exposed integral cement finish: tamp concrete to force aggregate away from surface and screed.

Float surface and trowel lightly. When concrete has set sufficiently to ring under trowel, do a second troweling to produce a smooth, dense surface free from trowel marks, sweeps, air bubbles, and other troweling imperfections.

B. Exterior entrances and walks: Finish as in "A", except omit second troweling. Brush with a light broom at right angles to direction of pedestrian travel. Score to patterns indicated with small radius edging tool to a minimum 1/2" depth.

3.04 CURING AND PROTECTION.

Conform with ACI 605.

3.05 COMPLETION.

Fill in holes and openings left in concrete for the passage of work of other trades after their work is in place. Mix, place, and cure to blend with in-place construction. Provide other miscellaneous filling required to complete work.

END OF SECTION

DIVISION 4

MASONRY

MORTAR

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE.

A. CONCRETE UNIT MASONRY -- SECTION 04220

1.02 REFERENCE STANDARDS.

ASTM: American Society for Testing and Materials.

PART 2 - PRODUCTS

2.01 MATERIALS.

A. Cement: Portland cement: ASTM C-150, Type I.

B. Hydrated lime: hydrated lime of Plastaid: ASTM C-207, Type S.

C. Aggregates:

1. Sand: ASTM C-144.

2. Pea gravel: graded with not more than five percent passing the No. 8 sieve and 100 percent passing the 3/8" sieve.

D. Water: clean and free from injurious amounts of oils, acids, alkalies, organic materials, and other deleterious substances.

E. Admixture: Omicron or approved equal.

2.02 MIXES.

A. General:

Proportion materials for mortar and grout by volume, so that specified proportions can be controlled and accurately maintained. Mix using a mechanical batch-mixer, at least three minutes for mortar and five minutes for grout. Hand-mixing may be permitted in small amounts if approved by Architect.

B. Mortar:

Prepare fresh and mix to uniform consistency in one of the following proportions to obtain 2000-psi, 28-day compressive strength. Admixture may be added in accordance with manufacturer's specifications. Use sufficient water to produce satisfactory workability.

1. 1 part cement
   1/4-part hydrated lime
   3 parts sand

2. 1 part Kaiser Mortar or Super Mortar
   3 parts sand

C. Grout:

Prepare fresh and mix to uniform consistency in the following proportion to obtain 2500-psi, 28-day compressive strength. Use sufficient water to produce a fluid consistency for pouring, yet not so fluid that constituent parts separate when grout is poured.

1. 1 part cement
   2 parts sand
   1 part pea gravel

Not more than 1/10-part hydrated lime to one part cement may be added.

CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.01 WORK INCLUDED.

A. Furnish and install all hollow masonry units.

B. Furnish and install all horizontal reinforcing.

C. Install vertical bar reinforcing.

D. Set all anchors, bolts, nailers, etc.

1.02 RELATED WORK SPECIFIED ELSEWHERE.

A. CAST-IN-PLACE CONCRETE -- SECTION 03300: embedded items.

B MORTAR -- SECTION 04100

1.03 REFERENCE STANDARDS.

HLBCMU: "Hollow Load-Bearing Concrete Masonry Units."

1.04 STORAGE AND HANDLING.

Stack masonry units carefully before using. Protect units from weather by cover or inside storage. Handle all units with reasonable care to prevent marring or damaging faces, edges, and corners. Do not dump units from hand trucks or wheelbarrows.

PART 2 - PRODUCTS

2.01 MATERIALS.

A. Hollow concrete masonry units: HLBCMU, Grade N, 2-core type, 8" nominal height, with length and thickness as indicated on drawings. Provide units for jambs, corners, lintels, and other special shapes as required.

B. Horizontal reinforcement: trussed or ladder design with #9 gauge deformed side rods and welded #9 gauge cross rods, equivalent to Dur-O-Wall, Wall-Lok, Blok-Mesh, or approved equal.

C. Mortar and grout: as specified in Section 04100

D. Anchors, bolts, nailers, etc., described in other sections of this document.

PART 3 - EXECUTION

3.01 INSPECTION/PREPARATION.

A. Vertical reinforcing dowels and splices: lap as indicated on drawings but not less than 30 diameters or 15 inches, whichever is longer. Install one #5 bar in end cells and fill cells with grout at jambs of doors, windows, and other openings, at corners and at ends of walls. Extend bars at least 24" beyond corners of openings.

B. Horizontal reinforcing: space as indicated on drawings. Lap ends at least six inches.

C. Anchors, bolts, nailers, etc.: Grout with sufficient mortar to make secure. Coordinate with other trades as necessary.

D. Masonry units:

1. Clean and wet beds on which masonry is laid.
2. Build work plumb, level, square, and true.
3. Drill, cut, and fit neatly, as required for other trades, with a power-driven carborundum saw.
4. Place anchors, bolts, ties, conduits, and similar items, as the work progresses.
5. Carry walls, partitions, and interior walls to the underside of beams, slabs, or joists, and wedge at top.
6. Grout metal door frames solid.
7. Do not wet masonry units before using.
8. Lay up walls in straight uniform course with regular running bond, unless other bond pattern is shown.
9. Lay masonry units in full mortar beds. Butter vertical head joints for a thickness equal to the face shell of the block. Shove mortar tightly so that it bonds securely to both blocks. Fit joints solidly from face of block to the depth of face shell.
10. If it is necessary to move a block to open a joint, remove block, clean, and set in fresh mortar.
11. Make mortar joints straight, clean, and in uniform thickness of 3/8". Tool exposed joints with a two-foot long round bar to produce a dense, slightly concave surface, well-bonded to block at edges. Compact the mortar by tooling, pressing out excess mortar, rather than dragging it out. Strike joints flush where walls will receive cement wash or where unexposed, such as below finish grade. See drawings for areas of special tooling for joints.
12. Build masonry units to preserve unobstructed vertical continuity of cells to be filled. Full-bed, in mortar, all walls and cross webs of such cells to prevent leakage of grout.

13. Fill cells containing reinforcement solidly with grout in lifts not exceeding eight feet. Fill other cells as indicated or where required to be solid for anchors or other such items. Form horizontal construction joints by stopping the pour of grout 1-1/2" below the top of the uppermost unit whenever grouting is stopped for one hour or longer.
14. Exercise extreme care to prevent mortar splotches where masonry walls will be unpainted. Make forms tight and wash off concrete or grout spilled on wall, before it sets up. Protect walls against stains and wipe excess mortar off surface as work progresses. Do not saturate wall with water for curing.

3.03 CLEANING.

A. Point holes and defective mortar joints in exposed masonry at completion of work. Cut out and repoint defective joints where necessary.

B. Clean all exposed masonry of mortar droppings, sand, and splotches to Architect's satisfaction. If scrubbing with stiff brushes and water is not sufficient, wet surface with clear water and scrub with a solution of not more than one part hydrochloric or muriatic acid to nine parts water; rinse thoroughly immediatly with clear water. Carefully protect all adjoining work which is subject to damage.

C. Remove all surplus material, waste material, rubbish, and debris from the premises when work is completed. Leave premises in clean and satisfactory condition.

DIVISION 5

METALS

STRUCTURAL STEEL

PART 1 - GENERAL

1.01 WORK INCLUDED.

A. Structural steel beams: fabrication and erection.

B. Steel support framing: fabrication and erection.

C. Welding and bolting of anchors, clips, and/or accessories.

D. Cutting and hole punching.

E. Painting.

1.02 RELATED WORK SPECIFIED ELSEWHERE.

A. CAST-IN-PLACE CONCRETE -- SECTION 03300: embedded items.

B. METAL DECKING -- SECTION 05300

C. METAL BUILDING SYSTEMS -- SECTION 13122

D. PAINTING -- SECTION 09900

1.03 QUALITY ASSURANCE.

A. Welders: certified as approved by testing laboratory in conformance with local building code and by tests prescribed in reference standard below.

B. Steel frame erectors: professional riggers.

1.04 REFERENCE STANDARDS.

A. AISC: American Institute of Steel Construction, "Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings."

B. AWS: American Welding Society Standard Code, D10.

C. AWS: American Welding Society, "Specifications for Iron and Steel Arcwelding Electrodes."

D. AWS: American Welding Society "Code for Arc-and Gas-Welding in Building Construction."

E. ASTM: American Society for Testing and Materials.

F. Federal Specifications TT-P-57B and TT-86-A.

1.05 SUBMITTALS.

A. Submit shop and erection drawings to Architect for approval before beginning fabrication or erection. Include minor connections and fastenings not specifically indicated but required to complete work.

B. Obtain Architect's approval for cutting, drilling and/or punching required for fastening or passage of work specified elsewhere.

1.06 COORDINATION.

A. Structural steel: ASTM A-36.

B. Bolts and nuts: AISC American Standard Regular design conforming with ASTM A-307 or A-325, as indicated on drawings, and galvanized.

C. Arc-welding electrodes: AWS (Reference Standard C above), ASTM A-233, Class E-70, suitable for the positions and other conditions of intended use.

D. Paint for shop priming and field touch-up: Federal specification TT-P-57B, Type 1, or TT-86-A, Type 3, or one of the following:

1. Tnemec #99 Red Metal Primer manufactured by Tnemec Co., Inc., North Kansas City, Missouri.

2. Rust-Oleum X-60 red base metal primer zinc chromate primer manufactured by Rust-Oleum Corp., Evanston, Illinois.

3. Other as approved by Engineer.

PART 2 - MATERIALS

2.01 FABRICATION.

A. Shapes: AISC.

B. Shop painting: Shop painting all structural steel except zinc-coated surfaces and parts to be embedded in concrete or mortar. Do not coat contact surfaces to be welded within three inches of the weld. Remove all mill scale, rust, dirt, grease, and other deleterious materials to insure a dry, clean surface for paint application. Apply paint to obtain a dried film thickness of not less than 1.5 mil. Promptly repair damaged coating with paint.

C. Welding: AWS (Reference Standard D above), and AISC.

1. Cut out and replace defective welds.

2. Use electric-arc process with coated rods, not fluxed, to produce a shielded arc.

3. Insure that surface seams and joints to be welded are free of rust, scale, grease, and other foreign material.

4. Make welds free of craters, occlusions, cracks, and porosity with physical and chemical characteristics equal to or better than those of material being welded.

5. Increase length of fillet welds indicated on drawings by at least twice weld size. Length indicated is the minimum effectire length and must be increased to allow for beginning and ending weld.

PART 3 - EXECUTION

3.01 WELDING.

A. Perform welding as specified above under FABRICATION.

3.02 ERECTION.

A. Report immediatly to Architect errors in shop fabrication or deforming caused by handling or transportation which prevent proper assembly and fitting of parts. Obtain Architect's approval of method of correction.

B. Erect frame so that minimum cutting is required, assuring that frame is plumb, square, and true to line and level. Use temporary bracing and guys wherever necessary to provide for predictable loads and stresses, including those caused by erection equipment and its operation.

C. Fit members and sections close, true to line, and in precise position required to permit proper joining of parts. Light drifting to draw parts together will be acceptable, but drifting to enlarge unfair holes will not be allowed. Do not heat rolled sections except for minor details.

D. Use temporary bolting as erection progresses to secure steel in position during field bolting and welding and as necessary to provide for loads and stresses. Do no field welding until work is aligned, plumbed, and leveled.

E. Use cutting torch only with Architect's approval where metal being cut is not carrying stress during operation and where stresses will not be transmitted through a flamecut surface. Make cuts smooth and regular in con-

tour. Determine effective width of members cut in this manner by deducting 1/8 inch from width of cut edges. Make the radius or re-entrant gas cut fillets as large as practicable but not less than one inch.

F. Locate finished holes precisely to insure passage through assembled materials without drifting. Enlarge holes by reaming as necessary to receive material. Poor matching of holes is sufficient cause for rejection.

3.03 FIELD PAINTING.

A. After erection, clean field welds, field bolts, and abraded portions of the work and provide a spot coat of the same materials to provide complete and uninterrupted protection of exposed metal.

METAL DECKING

PART 1 - GENERAL

1.01 REFERENCE STANDARDS.

ASTM: American Society of Testing and Materials.

1.02 SUBMITTALS.

Submit shop and setting drawings for approval before starting work under this section.

1.03 DELIVERY AND STORAGE.

Deliver materials to site in package lots with manufacturers' labels intact and seals unbroken, subject to Engineer's inspection before opening.

1.04 RELATED WORK SPECIFIED ELSEWHERE.

A. STRUCTURAL STEEL -- SECTION 05120

B. PAINTING -- SECTION 09900

C. METAL BUILDING SYSTEMS -- SECTION 13122

PART 2 - PRODUCTS

2.01 MATERIALS.

A. Metal floor decking: gauges indicated on drawings and galvanized per ASTM A-525.

B. Metal roof decking: prefinished deep corrugated decking by Star Manufacturing Company.

C. Metal siding: prefinished Starmark rib panels by Star Manufacturing Company.

D. Arc-welding electrode: as specified in SECTION 05120, STRUCTURAL STEEL.

E. Paint: as specified in SECTION 05120, STRUCTURAL STEEL.

PART 3 - EXECUTION

3.01 HOLES FOR OPENINGS.

A. Cut decking to fit openings located and dimensioned as indicated on drawings.

B. Cut and reinforce where necessary those holes required for work specified elsewhere which are less than 12"x12" and have no indicated location.

3.02 FIELD TOUCH-UP.

Repair, correct and/or grind smooth all surfaces abraded or deformed by erection and exposed welds, where necessary to leave a smooth, uniform surface for application of work specified elsewhere, and touch-up with paint.

3.03 CLEANING.

Leave finished surfaces free of dirt, grease, or other foreign material.

METAL FABRICATIONS

PART 1 - GENERAL

1.01 WORK INCLUDED.

A. Fabrication and installation of metalwork not specified elsewhere.

B. Shop and field welding, drilling, cutting, connecting.

C. Shop painting.

1.02 RELATED WORK SPECIFIED ELSEWHERE.

A. CAST-IN-PLACE CONCRETE -- SECTION 03300: concrete embedded items.

B. PAINTING -- SECTION 09900

1.03 REFERENCE STANDARDS.

A. ASTM: American Society for Testing and Materials.

B. AISC: American Institute of Steel Construction.

1.04 SUBMITTALS.

Submit shop drawings of work for approval before beginning work on this section. Design members and connections for portions of work not indicated on drawings. Show manner of fabrication of work and size and extent of welds, bolts, etc.

PART 2 - PRODUCTS

2.01 MATERIALS.

A. Structural steel: ASTM A-36.

B. Miscellaneous metals: commercial-quality mild steel.

C. Steel tubing: ASTM A-450, galvanized.

D. Galvanizing: ASTM AA-123.

E. Post-setting grout: Por-Rok or lead and sulphur.

F. Paint: epoxy paint.

G. Primer: approved by Architect.

H. Railings: black iron pipe.

2.02 FABRICATION.

A. General:

Work shall be shop-fitted and shop-assembled where practicable, as detailed in approved shop drawings. Follow applicable AISC codes and manuals. Finish exposed work smooth with even, close joints and neat connections. Profiles shall be true to detail, clean, straight, and sharply-defined.

B. Preparation:

Clean material before fabrication.

C. Cutting and drilling:

Provide holes for fabrication and for attachment of work specified elsewhere. Countersink holes for rivets and screws. Cope pipe railing joints.

D. Priming:

1. Clean surfaces of grease, rust, and loose mill scale before priming.

2. Prime ferrous metalwork, except work to be galvanized, with one shop coat of primer. Do not prime areas to be welded or embedded in concrete. Where metal is only partially in contact with concrete, entire surface may be painted. Do not prime in wet weather unless material is protected from dampness. Work paint into joints with brush.

E. Isolation of metals:

Separate dissimilar metals where they come in contact with one another or with concrete, in order to prevent corrosion.

F. Welding:

Weld (continuous) pipe railing joints and grind weld smooth.

G. Painting:

1. Paint surfaces of ferrous metalwork which will be inaccessible after erection.

2. Paint pipe railings, handrail, supports, and steel rungs.

H. Galvanize metal checkered plate covers, gratings and frames, down spouts, down spout guards, and straps.

I. Sizing pipe sleeves:

Size pipe sleeves through concrete to provide a space of not less than 1/4" all around between the sleeve and the pipe to be accommodated.

PART 3 - EXECUTION

A. Furnish templates, dimensions, and instructions for setting of embedded items as required in Section 03300.

B. Erect all work plumb, square, and true. Fit accurately with tight joints and intersections. Brace, reinforce, and anchor in place.

C. Repaint damaged areas with shop coat of paint after erection. Clean and paint welded areas. Use same primer and paint as used in shop.

DIVISION 6

WOOD AND PLASTICS

CARPENTRY, MILLWORK AND RELATED ITEMS

PART 1 - GENERAL

1.01 WORK INCLUDED.

A. Carpentry, millwork, casework, miscellaneous woodwork.

B. Installation of windows, door frames, and doors.

C. Installation of finish hardware, toilet compartments, bathroom accessories, and miscellaneous specialty items.

1.02 RELATED WORK SPECIFIED ELSEWHERE.

A. FLASHING AND SHEET METAL -- SECTION 07600

B. METAL DOORS AND FRAMES -- SECTION 08100

C. ALUMINUM DOORS AND FRAMES -- SECTION 08120

D. WOOD DOORS -- SECTION 08210

E. HARDWARE -- SECTION 08700

F. GYPSUM WALLBOARD SYSTEMS -- SECTION 09260

G. MISCELLANEOUS SPECIALTY ITEMS -- SECTION 10050

H. COMPARTMENTS AND CUBICLES -- SECTION 10150

I. TOILET AND BATH ACCESSORIES -- SECTION 10800

J. SERVICE AND DISTRIBUTION -- SECTION 16400

1.03 REFERENCE STANDARDS.

A. AWPB: American Wood Preservers Bureau.

1.04 SUBMITTALS.

A. Submit shop drawings covering items of trim and miscellaneous work before starting work.

1.05 HANDLING.

Use extreme care in handling finish materials to avoid scratches, bruises, or disfigurement.

PART 2 - PRODUCTS

2.01 MATERIALS.

A. Lumber in general: new, dry, sound, undamaged, well-seasoned, free from defects which impair strength or durability. Pieces shall bear grading marks of a recognized organization whose regular business it is to establish lumber grades. Mill size and surface on four sides except where indicated otherwise on drawings. Moisture content shall not exceed 20 percent. When installed, exposed lumber shall have no blemishes, objectionable marks, stains, or scars.

B. Foundation sill plates, wood in contact with concrete, masonry or dry packing: Foundation-grade Redwood or Douglas Fir pressure-treated with chromated zinc chloride or Wolman Salts. Any part made raw by sawing or notching shall be touched-up with brush.

C. Concealed studs, cripples, plates, blocking, bridging, backing, door bucks, and miscellaneous concealed rough carpentry: standard-grade Douglas Fir.

D. Beams, joints, headers, girders, rafters, ledgers, and miscellaneous horizontal framing members: No. 1 Douglas Fir.

E. Exposed posts, mullions, beams, false beams, and miscellaneous exposed framing, including members indicated on drawings: Appearance-grade Douglas Fir. Hand-select for appearance.

F. Plywood: Douglas Fir, laminated veneers: Grade A-A where exposed on two sides; Grade A-B where one side is concealed; Grade C-D where fully-concealed.

G. Particle board: Novoply, Duraflake, Armstrong, Celotex, Simpson, or Johns-Mansville.

H. Redwood: all heart Redwood, KD, S4S.

I. Wood panel siding: Simpson, premium-grade Douglas Fir plywood, rustic, ruf-sawn surface, 5/8" thick, pattern #8, grooves 8" o.c.

J. Door frames: Exterior: Douglas Fir; Interior: white pine economy WIC grade.

K. Interior trim: pine, economy grade, ready for paint finish.

L. Glue: waterproof, phenol resin, fungus-resistant.

M. Damp-proofing felt: 40-pound, asphalt-saturated strip.

N. Countertops: 1/16" plastic laminate, color-selected by Owner.

O. Veneer adhesive for countertops: modified urea-formaldehyde, such as Urac-185 glue, Super Fast Dry, Spray Mic, or Safe Bond.

2.02 PRESERVATIVE TREATMENT FOR WOOD.

A. Concealed framing lumber, general use lumber, and concealed plywood: treat with Wolman Salts (ELAP or CTA), or Osmosalts (K-33) (CCA), according to AWPB standard LP-2; dry after treatment.

PART 3 - EXECUTION

3.01 ROUGH CARPENTRY.

A. Apply continuous strip of damp-proofing felt under wood members which bear on concrete or masonry and in other non-bearing contact areas.

B. Erect framing true to line, plumb, level, and square, with proper fastening and bracing.

C. Cut as necessary to accommodate pipes and vents.

D. Set joists and beams with crown edge up.

E. Replace warped or bent studs not acceptable to receive wall cover. Replace or trim lower or upper plates which are split and protrude 1/8" or more beyond wall line.

F. Remove nails which protrude through roof, before roofing is applied.

G. Insure that rafter tails do not vary more than 1/4" horizontally.

3.02 FINISH CARPENTRY.

A. Exposed wood: use lengths as long as practicable in order to minimize joints.

B. Set exposed nailheads to receive putty, except where wood is to be stained.

C. Form joints to conceal shrinkage and finish tightly.

D. Sand wood with the grain. No coarse sandpaper marks, hammer marks, or other imperfections will be accepted.

E. Set frames plumb, level, and square. Brace until firmly in place. Use at least three shims on each side. Shim

jambs firmly at butts and striker plates.

F. Join lengths of running trim only where solid fastenings can be made. Miter exterior corners and cope interior angles.

G. Cut casework where necessary to receive vents and pipes. Allow no more than 1/4" in excess of outside dimension of vent or pipe.

H. Set cabinets and vanities and anchor securely in place.

I. Hang doors with even margin at side and top, with bottom cut to clear the specified floor covering.

J. Hang sliding doors plumb and true so that doors glide freely.

K. Support closet shelving on continuous cleats at walls and brace securely against warping and sagging.

L. Install 1"x4" sheathing on base units where ceramic tile counters will be installed.

3.03 MISCELLANEOUS.

A. Install steel doors and frames as specified in SECTION 08100.

B. Install aluminum doors and frames as specified in SECTION 08120.

C. Install wood doors as spcified in SECTION 08210.

D. Install finish hardware as specified in SECTION 08700.

E. Install miscellaneous specialty items as specified in SECTION 10050.

F. Install toilet compartments as specified in SECTION 10150.

G. Install toilet accessories as specified in SECTION 10800.

END OF SECTION

GLUE-LAMINATED STRUCTURAL UNITS

PART 1 - GENERAL

1.01 WORK INCLUDED.

A. Fabrication and installation of Glu-laminated beams.

1.02 REFERENCE STANDARDS.

A. WCLA: West Coast Lumbermen's Association.

B. AITC: American Institute of Timber Construction.

1.03 SUBMITTALS.

A. Submit shop drawings to Engineer before fabricating beams.

PART 2 - PRODUCTS

2.01 MATERIALS.

A. Beams: manufactured by Standard Structures, in finish, size, camber, and species as indicated in Beam Schedule.

PART 3 - EXECUTION

3.01 Comply with WCLA specifications and AITC standards of workmanship and construction.

END OF SECTION

DIVISION 7

THERMAL AND MOISTURE PROTECTION

MEMBRANE ROOFING

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE.

A. FLASHING AND SHEET METAL -- SECTION 07600

1.02 WARRANTY.

A. Provide a written warranty, signed by roofer, guaranteeing roofing membranes and flashings to be watertight for 10 years following date of acceptance of work.

PART 2 - PRODUCTS

2.01 PRODUCTS.

A. Roofing system: Johns-Manville Specification No. 400, or equal.

PART 3 - EXECUTION

3.01 APPLICATION.

A. Install cant strips at intersections of roof surface with vertical walls, curbs, offsets, etc. Turn roofing layers up against cant strip and trim evenly with upper edge of cant strip.

B. Install flashing and drains which come in contact with roof as specified under SECTION 07600: FLASHING AND SHEET METAL.

C. Fit roofing neatly around pipes, vents, drains, etc., and seal with plastic roof cement. Embed metal flashing flanges in hot asphalt between layers of roofing. Seal edges in roofing with 6" wide asphalt-saturated web fabric mopped on.

FLASHING AND SHEET METAL

PART 1 - GENERAL

1.01 WORK INCLUDED.

A. Installation of flashings, reglets, edgings, gutters, downspouts.

1.02 RELATED WORK SPECIFIED ELSEWHERE.

A. CARPENTRY, MILLWORK, AND RELATED ITEMS -- SECTION 06000

B. MEMBRANE ROOFING -- SECTION 07500

C. METAL BUILDING SYSTEMS -- SECTION 13122

1.03 REFERENCE STANDARDS.

A. SMACNA: Sheet Metal and Air Conditioning Contractors National Association standards.

B. ASTM: American Society for Testing and Materials.

1.04 SUBMITTALS.

A. Submit shop drawings before fabricating for items which require shop fabrication. Use verified field conditions to prepare drawings.

1.05 WARRANTY.

Provide a written warranty guaranteeing work under this section to be free of defects of materials and workmanship for two years from date of acceptance of work. Defects shall include the following types of failures: leaking, failure to stay in place, undue expansion, lifting, deformation, loosening, and splitting of seams.

PART 2 - PRODUCTS

2.01 MATERIALS.

A. Galvanized sheet steel: ASTM A-93, flat zinc-coated sheets with manufacturer's stamp indicating product name on each sheet. Use gauges no lighter than indicated on drawings and never lighter than 24-gauge.

B. Solder: ASTM B-52, 50% lead and 50% block tin, new metal.

C. Flux for soldering: muriatic acid "killed" with zinc or an approved brand of soldering paste. Flux used with aluminum must be fluid at soldering temperature.

D. Miscellaneous nails, rivets, fastenings, hangers, straps: galvanized.

E. Reglets: 24-gauge galvanized steel spring lock flashing system manufactured by Fry Reglet Corporation as follows:

1. At concrete wall, use Fry Type CO.

2. At concrete masonry units, use Fry Type MA.

PART 3 - EXECUTION

3.01 INSTALLATION.

A. General:

1. Conform with SMACNA standards of workmanship. Form work accurately and fit snugly against walls. Fold exposed edges under at least 1/2". Leave no sharp corners exposed. Shield materials against galvanic action with asphalt-base paint or equivalent. Fasten work securely and make absolutely watertight. Provide for expansion and contraction.

2. Coat all metal surfaces with heavy coat of bituminous paint where contact with dissimilar metal, masonry, or concrete will occur. Provide underlayment of water-proof paper of asphalt-saturated felt for sheet metal linings or coverings which come in contact with concrete.

3. Clean surfaces before soldering. Solder slowly with well-heated tools so as thoroughly to heat sheet and completely seat solder through full width of seam. Make lock seam work flat and true to line and sweated full of solder. Make flat lock seams and soldered lap seams at least 1/2". Lap unsoldered lap seams according to pitch but never less than three inches.

4. Make flat and lock seams in the direction of drainage flow. Thoroughly wash acid flux work after soldering.

5. Clean surfaces which will be concealed after installation by removing grease and oil with solvent and wiping with clean rags.

6. Secure metal by means of cleats with nailing through metal, whenever possible. Space nails, rivets, or screws not more than eight inches apart. Use lead washers where exposed to weather. Use Dryvins and drilled holes for nailing into concrete or masonry.

7. Join parts with concealed rivets or sheet metal screws where necessary for strength or stiffness. Place sheets together before drilling. Lap the lap joints at least four inches.

8. Install metal work on roofs as roofing work is performed.

9. Lap flashing at least four inches on ends.

10. Space miscellaneous clips not more than 24" o.c.

B. Roof flashings:

Install flashings and counterflashings at junctions of roofs with vertical surfaces, at points indicated on drawings, and at all points necessary to make this work watertight. Install counterflashing as roofing work is performed. Extend counterflashing down to intersection of roofing with wall. Lap at joints and around corners.

C. Metal edgings:

Use pressure-treated lumber as specified in SECTION 06000: CARPENTRY, MILLWORK, AND RELATED ITEMS, wherever wood edge strips or screeds are required.

D. Gutters and scuppers:

Anchor downspouts secrurely to walls with galvanized sheet steel straps.

E. Reglets:

Install types as specified in this section under PRODUCTS.

3.02 FIELD QUALITY CONTROL.

Carefully examine and, if necessary, test sheet metal work before completing work.

3.03 CLEANING.

Clean soldering flux from all work. Leave work in satisfactory condition to receive paint, if galvanized.

SEALANTS

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE.

A. METAL BUILDING SYSTEMS: SECTION 13122

1.02 WARRANTY.

A. Provide a written warranty guaranteeing work covered in this section to be free from defects of materials and workmanship for two years from date of final acceptance of work.
B. Repair and replace all such defective work and all work damaged thereby during term of warranty.
C. Include the following types of failures as defects: leakage, hardening, cracking, crumbling, melting, shrinkage, running of compound, or staining adjoining areas of work.

PART 2 - PRODUCTS

2.01 MATERIALS.

A. Caulking compound: polysulfide rubber sealant, gun grade, color as approved by Architect, as follows:

1. For joints around frames of doors and window openings: DAP; one part Acrylic Terpolymer sealant or Acrylic Terpolymer or Sonolastic and one part Polysulfide sealant or PRC Rubber Caulk 5000 sealant.

2. For joints at critical floor and wall expansion conditions: one part Tremco Lasto-Meric and two parts Polysulfide.

B. Joint primer: as recommended by caulking compound manufacturer.

C. Joint backing: polyester, polyurethane foam at least twice as wide as joint to be caulked.

2.02 DELIVERY, STORAGE, HANDLING.

A. Deliver materials and store in original unopened packages and protect from damage.

PART 3 - EXECUTION

3.01 APPLICATION.

A. Caulk the periphery of openings and other locations where building joints occur, outside and inside, and all crevices as required to provide weatherproof closures. Caulk frames at louvers, windows, and doors.

B. Clean joints and spaces to be caulked, free of dust, dirt, oil, grease, and dampness. Do not caulk joints until they comply with details as indicated on the drawings.

C. Pack joints which are wider than 1/4" with the spcified joint backer forced into the joint to within 1/2" of the surface.

D. Prime joints of wood, concrete, or masonry and allow to dry 30 minutes before caulking.

E. Apply caulking compounds with pressure gun which has nozzles to fit into joints. Fill joints solidly and smoothly, without thin edges. Remove excess compound and leave adjoining surfaces clean.

F. Complete caulking before final coat of paint is applied.

DIVISION 8

DOORS AND WINDOWS

METAL DOORS AND FRAMES

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE.

A. CARPENTRY, MILLWORK, AND RELATED ITEMS -- SECTION 06000

B. HARDWARE -- SECTION 08700

1.02 REFERENCE STANDARDS.

A. NBFU: National Board of Fire Underwriters.

1.03 STORAGE.

A. Store doors under cover on building site on wood sills or on floors in a manner to prevent rust and damage.

PART 2 - PRODUCTS

2.01 MANUFACTURER.

A. Doors and frames shall be Steelcraft as manufactured by the Steel Craft Manufacturing Company.

2.02 FABRICATION.

A. General:

Galvanize doors and frames.

B. Full flush doors:

Construct faces of 1-3/4" doors with 18-gauge, cold-rolled, leveled sheet steel to obtain a smooth, seamless, unbroken surface on both faces. Form interior structure of door with 18-gauge cold-rolled channels in a ladder or grid pattern construction. Double-weld this grid at all junction points and attach hardware reinforcements with multiple welds. Form top and bottom of door flush with grid. Dip-coat grid structure after assembly and welding with a phosphatic base paint to etch and make it completely corrosion-proof before assembling door. Cap the top of exterior doors. Mortise and reinforce doors for locks and hinges with not less than U.S. 14-gauge. Extend hinge reinforcements not less than 5" into interior of door.

C. Door frames:

Use 16-gauge steel. Make frame faces 2" wide and stops 5/8", and of the depth indicated on drawings. Construct jambs to set on finished floor. Ship frames knocked-down. Mortise and reinforce frames with heavy-gauge reinforcements for hinges and lock strikes. Furnish sill anchors and three jamb anchors per jamb.

D. Labeled door and frame:

Doors and frames indicated on drawings as labeled shall be full flush series 1-3/4" thick, 16-gauge galvanized as specified above, except all items shall meet NBFU requirements and be so labeled.

E. Shop finish:

Protect doors inside and outside against corrosion; phosphatize, factory prime paint, and sound-deaden. Bonderize frames and apply one coat of baked-on metallic primer.

PART 3 - EXECUTION

3.01 Installation of frames and doors: follow manufacturer's instructions.

ALUMINUM DOORS AND FRAMES

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE.

A. CARPENTRY, MILLWORK, AND RELATED ITEMS -- SECTION 06000

B. HARDWARE -- SECTION 08700

C. GLAZING -- SECTION 08800

1.02 REFERENCE STANDARDS.

A. AAS: Aluminum Association Standards.

1.03 SUBMITTALS.

A. Submit shop drawings for approval.

1.04 WARRANTY.

A. Warrant work against defective materials or workmanship for one year following acceptance of work.

PART 2 - PRODUCTS

2.01 MANUFACTURER.

A. Arcadia Company.

2.02 MATERIALS.

A. Doors and frames: narrow stile 190 entrances. Extrude sections of doors and frames from 6063-T5 aluminum alloy. Make major portions of door stiles 0.125" thick and glazing mouldings 0.050" thick.

2.03 FABRICATION.

A. Construction:
Join door stiles and rails securely and reinforce with structural corner assemblies. Incorporate two woven pile weatherstrips from top to bottom in welded hinge in stiles of double-acting doors and in lock stiles of pairs of doors. Use snap-in type glazing stops with exposed screws. Use lock-in tamper-proof type stops on exterior side. Equip door leaves with adjustable mechanism in top rail near lock stile to provide for minor clearance adjustments after installation.

B. Finish:
Finish all exposed members free of scratches and surface blemishes. Give aluminum a caustic etch and anodic oxide treatment which conforms with AAS-M21C22A31 (Aluminite 204AIRI) to obtain a dark bronze anodized finish.

C. Hardware:
Furnish and install door hardware at place of manufacture, including standard items as follows:

1. Maximum security lock, less cylinders. (Cylinders furnished under SECTION 08700: HARDWARE.)

2. Push-pull bars, style F.

3. Overhead concealed closer, Type M-2, center-hung.

4. Threshold.

5. Flush bolt on inactive leaves of pair doors.

D. Protective coatings:

Protect all exposed aluminum surfaces with a clear laquer coating, before shipment. Provide a heavy coat of zinc chromate paint for alumimum clips, anchors, and other loose parts which will come in contact with concrete, mortar, plaster, or dissimilar metals.

PART 3 - EXECUTION

3.01 INSTALLATION.

A. Anchor doors securely to a straight, plumb, and level condition without distorting frames or panel components and in strict conformance with manufacturer's installation details and instructions.

B. Glaze fixed panels with continuous vinyl channels with surface striations to prevent separation of glass and panels.

C. Install lock cylinders furnished under SECTION 08700, HARDWARE.

3.02 ADJUSTING/CLEANING/PROTECTION.

A. Check and readjust, as required, items of operating hardware on work of this section, after erection and glazing.

B. Clean metal surfaces of doors and protect against damage.

WOOD DOORS

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE.

A. CARPENTRY, MILLWORK, AND RELATED ITEMS -- SECTION 06000

B. HARDWARE -- SECTION 08700

1.02 REFERENCE STANDARDS.

A. NBFU: National Board of Fire Underwriters.

1.03 SUBMITTALS.

A. Submit shop drawings for approval.

PART 2 - PRODUCTS

2.01 MATERIALS AND FABRICATION.

A. Solid-core doors: flush, solid slab doors with 1/8" Philippine mahogany plywood on both faces of solid softwood core and with 4-1/2"-wide solid Douglas fir stiles. Fabricate in a manner to prevent warping, sagging, or buckling.

B. Hollow-core doors: with stiles and rails of kiln-dried Douglas fir: stiles 1-1/2"-wide, rails 4-1/2"-wide and lock blocks 3-1/2" x 20". Make veneers of Philippine mahogany three plies of standard thickness to form a panel 1/8" thick on each side of frame.

C. Louvers: 18-gauge galvanized steel door louvers as manufactured by air Louvers, Ltd. and as detailed on drawings.

D. Construct doors to NBFU directives, when required, and label such doors as so constructed.

PART 3 - EXECUTION

3.01 Mount doors accurately and install hardware furnished under SECTION 08700, HARDWARE.

HARDWARE

PART 1 - GENERAL

1.01 WORK INCLUDED.

A. Furnish and deliver to the building the finish hardware required for doors, casework, and similar items; hardware of every sort and description required to equip all movable parts of the building for perfect operation.

1.02 RELATED WORK SPECIFIED ELSEWHERE.

A. CARPENTRY, MILLWORK, AND RELATED ITEMS -- SECTION 06000

B. STEEL DOORS AND FRAMES -- SECTION 08100

C. ALUMINUM DOORS AND FRAMES -- SECTION 08120

D. WOOD DOORS -- SECTION 08210

1.03 DELIVERY.

A. Examine plans, details, and specifications in order to check all items for suitability, perfect fit, and delivery where and when required. Hardware shall be unit-packed, labeled, and numbered so that items can be checked against a hardware list furnished at time of delivery.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS.

A. Sargent, McKinney, Quality, and Best.

2.02 MATERIALS.

A. Finishes: oxidized bronze/oil-rubbed. Butts: tan prime.

B. Locks: Sargent and Company 08 design, grand-mastered for this project, each with two keys.

C. Rawl plugs: supplied with screws where hardware is applied to masonry or floors.

PART 3 - EXECUTION

3.01 Installation: follow manufacturer's instructions or recommendations.

GLAZING

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE.

A. ALUMINUM DOORS AND FRAMES -- SECTION 08120

1.02 REFERENCE STANDARDS.

A. FEDERAL SPECIFICATIONS.

PART 2 - PRODUCTS

A. Domestic glass: Federal specification DD-G-451, each pane labeled for type, strength, and quality.

B. Wire glass: 1/4" thick, clear wire glass.

C. Float glass: 1/4" thick, clear.

D. Safety glass: 1/4" thick, clear, tempered.

E. Glazing compounds:

1. Mastic type at wood framing.

2. Elastic type at metal sash and framing.

PART 3 - EXECUTION

3.01 MEASUREMENT.

Take all measurements for glass from the building or from finished millwork before delivery.

3.02 INSTALLATION.

A. Back-bed all glass set in glazing compound.

B. Fit glass securely into glazing beads provided under SECTION 08120: ALUMINUM DOORS AND FRAMES.

C. Glaze generally according to glass manufacturer's recommendations and allow proper clearance and bearing all around.

3.03 CLEANING.

Clear and wash the work of this section, remove dirt and putty stains and leave glass and mirrors polished. DO NOT remove labels before Architect's approval.

DIVISION 9

FINISHES

GYPSUM WALLBOARD SYSTEMS

PART 1 - GENERAL

1.01 WORK INCLUDED.

A. Drywall partition work.

B. Furring and concealment of plumbing.

1.02 RELATED WORK SPECIFIED ELSEWHERE.

A. CARPENTRY, MILLWORK, AND RELATED ITEMS -- SECTION 06000

1.03 DELIVERY AND STORAGE.

Deliver all materials to job in original containers or bundles and store in a place protected from damage and exposure to the elements.

1.04 SEQUENCING/SCHEDULING.

Coordinate with SECTION 06000 -- CARPENTRY, MILLWORK, AND RELATED ITEMS for bucks and grounds to secure the work of other sections.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS.

A. Celotex.

B. Pabco.

C. U.S. Gypsum.

2.02 MATERIALS.

A. Gypsum wallboard: 5/8" thick.

B. Gypsum coreboard: 1" thick, 24" wide, length as required by ceiling height.

C. Gypsum ceiling board: 5/8" thick, exterior.

D. Hanger wires: 8-gauge, galvanized.

E. Metal studs, floor and ceiling runners: rolled formed channels, 25-gauge electro-galvanized steel.

F. Joint treatment: PERF-A-TAPE system.

G. Laminating adhesive: Celotex joint system compound, ready-mixed compound, or 3-M Drywall Contact Adhesive.

H. Metal trim mouldings and miscellaneous metal accessories:

PART 3 - EXECUTION

3.01 INSTALLATION OF PARTITIONS AND FURRED SPACES.

A. Follow manufacturer's specifications.

B. Stud partitions: 1-5/8" or 3-5/8" or as indicated on drawings, with gypsum wallboard both sides. Where required for pipe spaces, build partitions to required thickness with 1-5/8" studs and gypsum wallboard.

C. Position studs vertically in runners no more than 24" on center unless indicated otherwise on drawings. Anchor studs to runner flanges by positive screw engagement through each stud flange and runner flange where studs are located adjacent to door and window frames, partition intersections, and corners.

D. Locate studs no more than two inches from rough door frames, abutting partitions, partition corners, and other construction.

E. Apply gypsum wallboard with long dimension parallel to framing members so that abutting ends and edges occur over stud flanges. Stagger end joints and place joints on opposite sides of partitions on different studs. Fasten along perimeter and at intermediate studs with Type S screws spaced 12" o.c.

F. For two-layer construction with mineral fiber sound deadening board, apply base layer sound deadening board vertically and stagger joints on opposite sides of partition. Attach board to metal studs with 1" Type S screws spaced 27" o.c. along vertical joints and at quarter mid-points of panel height along intermediate stud. Place two screws at each end of board through runner 1" from each vertical edge. Apply face layer vertically with joints staggered from base layer joints and laminate to base layer. Fasten face layer around perimeter with 1-5/8" Type S screws spaced 12" o.c.

G. Treat and finish joints, abutting inside corners, screw heads, and other depressions in the surface of the wallboard in accordance with PERF-A-TAPE system manufacturer's recommendations, ready to receive paint.

3.02 INSTALLATION OF GYPSUM BOARD CEILING.

A. Support carrying channels at not over four feet o.c. from wire hangers anchored to structure or overhead ceilings. Provide sufficient anchorage to develop the full strength of the hanger wires. Space carrying channels, as required, to accommodate furring channels, but never more than four feet o.c.

B. Locate furring channels at not more than 24" o.c. Wire-tie or anchor securely with suitable fastening. Splice ends with not less than 8" nesting and with a secure wire tie.

C. Apply gypsum board with long dimension at right angles to furring channels where practical. Center end-joints over furring channels. Use maximum end joints. Fasten as specified for partition construction. Provide suitable metal edge trim at ceiling angles and around cut-outs.

3.03 MISCELLANEOUS WORK.

A. Patch and smooth surfaces and joints if required after the work of other sections is completed. Correct faulty work in a manner approved by Architect.

B. Provide metal trim mouldings, standard wallboard corners, casing beads, and trims; and install where indicated in the drawings and as required.

CERAMIC TILE

PART 1 - GENERAL

1.01 REFERENCE STANDARDS.

A. Federal specifications.

B. USDC-SPR: U. S. Department of Commerce Simplified Practice Recommendation.

C. ASTM: American Society for Testing and Materials.

D. ANSI: American National Standards Institute.

E. TCA: Tile Council of America.

1.02 SUBMITTALS.

A. Submit samples of tile for color and pattern selection by Owner.

B. Submit Master Grade Certificate delivered with tile to Architect.

1.03 DELIVERY.

A. Deliver tile to site in manufacturer's sealed and labeled cartons

PART 2 - PRODUCTS

2.01 MATERIALS.

A. Ceramic wall tiles: Federal Specification SS-T-308b and USDC-SPR, R61-61, domestic manufacture standard grade. 4-1/2"x4-1/2", approximately 5/16" thick, glazed with semi-matte finish. Furnish with 4-1/4"x4-1/4" A-3401 cove bases and bullnose caps.

B. Ceramic floor tiles: standard quality, dust-pressed, machine-made, porcelain-type tile. Provide trim shapes as detailed and as required. Provide rounded convex external corners and square internal vertical corners. Round top of wainscot with full 4-1/2" bullnose caps and bottom with cove bases. Provide 4"-high base tiles with sanitary coved corners.

C. Portland Cement: ASTM C-150 Type 1.

D. Sand: clean and uniformly graded.

E. Water: potable.

F. Waterproof membrane: 15# building felt or 4-mil polyethylene.

G. Joint grout: commercial Portland cement waterproof tile grout, non-shrinking, white for walls, grey for floors. Portland Cement dry-set white grout optional.

H. Wire mesh: ANSI A-50.3, 2"x2", 16/16 gauge.

2.02 MIXES.

A. Mortar: prepare fresh and mix uniformly in drum-type batch-mixer for at least three minutes in the following proportions. Discard mortar that has reached its initial set. Do not retemper mortar.

1. 1 part Portland Cement.
2. 4 to 5 parts sand.
3. 1/2-part hydrated lime.

B. Scratch coat: mix in following proportions:

1. 1 part Portland Cement.
2. 4 to 5 parts sand.
3. 1/5 part hydrated lime.

C. Skim coat: Portland Cement mixed to the consistency of a thick, pasty cream.

D. Grout: mix to uniform creamy consistency.

PART 3 - EXECUTION

3.01 PREPARATION.

A. Conform with TCA recommendations for installation.

B. Clean surfaces and dampen thoroughly before placing mortar.

C. Reinforce setting beds at center with mesh. Make laps no less than 3".

D. Do not apply scratch coats or mortar setting beds until necessary grounds, hangers, anchors, and other items to receive plumbing fixtures or other fittings to be secured against the tile surface have been properly installed. Coordinate work with other trades.

3.02 APPLICATION.

A. Apply scratch coat plumb and true to a thickness no less than 1/4". Key coat properly with sufficient pressure and cross-scratch surface before initial set occurs. Allow to dry at least 24 hours.

B. Wet surface of scratch coat evenly but do not saturate. Apply mortar setting bed of 3/32" to 3/4" thickness. Attach temporary screeds with blobs of mortar to provide a plumb and true surface the proper distance back from the finish wall line. Apply, rod, and float mortar setting bed over areas no greater than will be covered with tile while setting bed remains plastic.

C. Use a skim coat 1/32" to 1/16" thick to bond tile to mortar setting bed. Soak tile in water at least 1/2 hour. Press and beat soaked tile into the plastic mortar setting bed to a true plane with uniform joints 1/16" wide or as determined by the spacers on the tile. Cut through setting bed horizontally and vertically every four courses of tile.

D. Grout after tile has set for at least 24 hours. Saturate joints with water and force grout into joints to full depth. Take care not to scratch glaze tile. Remove surplus grout before it hardens and leave face of tile clean.

3.03 CLEANING.

Upon completion of tile work, clean finished surface thoroughly. Do not use acid solution on glazed tilework.

ACOUSTICAL TILE

PART 1 - GENERAL

1.01 REFERENCE STANDARDS.

A. Federal Specification SS-5118a.

1.02 SUBMITTALS.

A. Submit tile samples, appurtenance samples, and manufacturer's specifications of the tile, suspension system, and fastener system.

1.03 COORDINATION.

Coordinate installation of the work of this section with installation of air conditioning ducts and registers and with installation of electric light fixtures.

PART 2 - PRODUCTS

2.01 MATERIALS/FABRICATION.

A. Tiles: Federal Specification referenced above as follows:
Type: III (mineral composition).
Pattern: b, c, d, e, or f.
Class: Class 25 (class I, U.B.C.).
Grades: SAC 65, SAC 70, or SAC 75.
Size: 24"x48"x5/8" minimum thickness.
Edges: Square.
Finish: White factory finish, minimum 75% reflectance.
Mounting: Lay-in type with exposed suspension grid system.

B. Suspension system: exposed-grid ceiling suspension system as follows:

1. Fire rating: one hour or more.

2. Grid: steel with baked-on enamel finish, treated and protected against rust and corrosion.

3. Main runners: spaced 24" or 48" o.c., supported with #12-gauge galvanized wire hangers not over 48" o.c.

4. Tees: install #12-gauge galvanized wire with neoprene gaskets at tees.

5. Cross-T splines: snap-in type with positive key lock.

6. Wall moulding and angles: rolled edges. Match exposed grid.

RESILIENT FLOORING

PART 1 - GENERAL

1.01 WORK INCLUDED.

A. Installation of resilient floor covering and base.

B. Cleaning, waxing, and polishing of floor.

1.02 QUALITY ASSURANCE.

A. All work shall be done by experienced tradesmen.

1.03 SUBMITTALS.

A. Submit samples of floor tiles and cove bases for color and pattern selection.

1.04 DELIVERY/HANDLING/STORAGE.

A. Deliver materials to jobsite in original unopened containers marked with grade and manufacturer's brand name. Handle and store materials carefully.

PART 2 - PRODUCTS

2.01 MATERIALS.

A. Flooring: vinyl asbestos tile, 12"x12"x1/8" thick, commercial-type as manufactured by Armstrong, Flintkote, Amtico, Kentile, or approved equal.

B. Cove base: vinyl, 4" high, 1/8" thick, set-on type.

C. Adhesives: waterproof and recommended by manufacturer for the specific materials and use.

D. Edging: vinyl, beveled 1"-wide strip, same thickness as tile.

PART 3 - EXECUTION

3.01 PREPARATION.

A. Clean subfloor free of dust, dirt, grease, and other foreign material. Broom, wet mop, scrub, and scrape to obtain smooth, level surface.

B. Concrete subfloor shall be clean, dry, and smooth.

C. Report defects such as ridges, holes, and cracks to Architect.

3.02 INSTALLATION.

A. Follow manufacturer's recommended specifications.

B. Where not contrary to manufacturer's recommendations, apply adhesive with notched trowel in thin, even coat. Lay tiles with tight joints in true alignment both ways. Heat underside of tiles if necessary to obtain satisfactory bond to subfloor. Cut tile to fit accurately at joining with other materials and at vertical surfaces.

C. Lay tiles symmetrically about center lines of room and work toward wall, so that border tiles are not less than half the width of field tiles. Reverse grain on alternate tiles. Install edging at edges of flooring not stopped by raised thresholds or vertical surfaces.

D. Apply cove base on dry walls. Take care not to stretch material during installation, because it will shrink and leave gaps at joints. Install top and bottom edges in firm contact with wall and floor. Use pre-molded interior corners or make job-formed corners with legs no less than 12" long.

3.03 CLEANING AND PROTECTION.

A. Remove spots of adhesive immediately as work progesses.

B. Allow adhesive to set before washing or waxing floor. Wait at least the minimum length of time recommended by manufacturer.

C. Clean flooring with neutral cleaner as recommended by manufacturer and then mop with clear water.

D. When dry, apply two coats of non-slip wax with lamb's wool mop. Buff each coat thoroughly with a weighted rotary electric floor-polishing machine.

E. Protect floors by keeping traffic off until final acceptance.

PAINTING

PART 1 - GENERAL

1.01 WORK INCLUDED.

A. Painting or treating exterior and interior surfaces, NOT including aluminum, stainless steel, plated surfaces, acoustical tile, laminated plastic, factory finishes, and similar surfaces.

1.02 RELATED WORK SPECIFIED ELSEWHERE.

A. CAST-IN-PLACE CONCRETE -- SECTION 03300: filling of voids.

B. STRUCTURAL STEEL -- SECTION 05120: painting.

C. METAL DECKING -- SECTION 05300: painting.

D. METAL FABRICATIONS -- SECTION 05500: painting.

E. SERVICE AND DISTRIBUTION -- SECTION 16400

1.03 SUBMITTALS.

A. Colors shall be as selected by Architect.

B. Submit samples of finishes applied on the type of materials as intended and at least 12"x12" in size.

1.04 DELIVERY/STORAGE/HANDLING.

A. Deliver materials to jobsite in original sealed containers bearing manufacturer's labels.

B. Store materials outside of building in a manner to prevent damage. Maintain precautions against fire. Observe recognized safety precautions and codes covering handling and storage of paints and thinners.

C. Store waste materials in proper metal containers, observing precautions as above.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS.

A. W.P. Fuller, Boysen, Pittsburgh, Devoe, B.F. Moore, A.C. Horn, DuPont, Sherwin-Williams, Glidden, General Paint, Sinclair, Schorn, Olympic, Old Colony.

B. Other approved as equal by Architect.

2.02 MATERIALS.

A. Primers: as specified below in SCHEDULE OF FINISHES by acceptable manufacturer.

B. Paint: same as 2.02A above.

C. Miscellaneous coating, textures, finishes, fillers, sealers, and conditioners: same as 2.02A above.

D. Paint thinners: pure linseed oil, pure gum spirits of turpentine, and as specified by paint manufacturer. Do not use compound thinners, mineral oils, kerosene, or gasoline for thinning.

2.03 MIXES.

A. Do all mixing ouside of building.

B. Tint each coat of paint a slightly different shade from the preceeding coat for easy identification of coats. Finish coat shall match approved sample.

PART 3 - EXECUTION

3.01 PREPARATION.

A. Do not begin work on surfaces that are unsuitable for proper finish of work. Notify Architect of unsuitable surfaces and proceed with work only when conditions are corrected or when instructed to proceed by Architect.

B. Apply one coat of shellac to wood knots and sappy spots before painting.

C. Wash unprimed galvanized metal with a solution of chemical phosphoric metal etch and allow to dry.

D. Fill voids between wall surfaces and wood or metal trim, or scribed edges, with putty, caulking material, or spackle, as required by the surface, to assure a smooth finish.

E. Clean, hand-sandpaper, and dust off all woodwork. Putty nail holes, cracks, and defects in woodwork after first coat. Match putty to stain color for stained surfaces. Sandpaper woodwork smooth after each and every coat except the last coat. Insure that surfaces are free of dust, dirt, and other imperfections before proceeding with additional coats.

F. Wire-brush and clean concrete and concrete masonry unit surfaces to remove dust and loose mortar. Use standard procedures and practices of the Associated General Contractors to cleanse and prepare surfaces before painting to remove form oils, waxes, or parting agents, extraneous residue, dirt, surface powder, chalk, effloresence, salts, etc. Obtain surfaces conditoned to assume a firm bond with paint materilas. Test concrete and concrete masonry unit surfaces with litmus paper or phenolphtalene to detect presence of chemically-active alkalis. Do not apply finishes to surfaces which show positive reaction.

3.02 APPLICATION.

A. Apply materials according to manufacturer's instructions and free from runs and sags. Apply no paint, varnish, or enamel until preceding coat is dry and hard.

B. Do no exterior painting in rainy or damp weather or until surface is dry.

C. Paint exposed piping, conduit, ducts, hangers, and similar surfaces not scheduled to a color and texture to match adjacent surfaces. (One primer, two coats finish.)

D. Obtain Architect's approval for each application, coat, and treatment before next application. Additional applications may be required if such approval is not obtained.

E. The phrase "exposed wood" in finish schedule below includes all wood finish members, wood door jambs, heads, mullions, built-in and movable cabinets, cases, and shelving room doors, cabinet doors, and trim. Finish tops, bottoms, and vertical edges of room doors and cabinet doors the same as adjoining vertical faces. Apply exterior finish to all surfaces of exterior doors.

F. Eliminate prime coats on finish schedule below for preprimed metal surfaces.

3.03 SCHEDULE OF FINISHES, EXTERIOR.

A. Exposed concrete masonry.

1. First coat: 664-W-24 textured block filler rolled and brushed. Spread 50 sq. ft. per gallon, undiluted.

2. Second coat: R-3045 fibrated plastic coating. Spread 75 sq. ft. per gallon, undiluted.

3. Third coat: 262-XX acrylic latex.

B. Exposed concrete.

1. First coat: 620-16 surface conditioner. Mix one gallon acrylic per five gallons of conditioner. Allow sufficient time for curing.

2. Second coat: 262-XX acrylic latex.

C. Exposed metal, metal floor decking, galvanized iron, etc.

1. First coat: 221-12 zinc dust primer (for galvanized). 621-04 Blox Rust Primer (for ferrous).

2. Second and third coats: 612-XX heavy-duty enamel.

D. Exposed wood, not including redwood.

1. First coat: 220-23 exterior wood primer.

2. Second and third coats: 260-XX house and trim paint.

E. Exposed redwood.

1. Two coats: semi-transparent stain.

F. Exposed cement plaster.

1. First coat: R-3045 fibrated plastic coating. Spread 50 sq. ft. per gallon, undiluted.

2. Second and third coats: 262-XX acrylic latex.

G. Parking lines, graphics, etc.

1. Two coats: traffic line paint.

3.04 SCHEDULE OF FINISHES, INTERIOR.

A. Exposed concrete masonry.

1. First coat: 220-22 PVA sealer.

2. Second and third coats: 213-XX semi-gloss enamel.

B. Exposed gypsum board and plaster.

1. First coat: 220-06 primer sealer.

2. Second coat: 220-06 primer sealer (colored).

3. Third coat: semi-gloss stipple finish.

NOTE: Gypboard ceiling shall be textured.

C. Exposed concrete.

1. First coat: 202-XX flat finish.

2. Second coat: 202-XX flat finish.

D. Exposed wood.

1. First coat: 220-07 enamel undercoat.

2. Second and third coats: 213-XX semi-gloss enamel.

E. Exposed metal and galvanized iron.

1. First coat: 621-04 Blox Rust Primer (ferrous metal). 221-12 zinc dust primer (galvanized).

2. Second and third coats: 612-XX heavy-duty enamel.

DIVISION 10

SPECIALTIES

MISCELLANEOUS SPECIALTY ITEMS

PART 1 - GENERAL

1.01 WORK INCLUDED.

A. Furnish and deliver:

1. Miscellaneous interior furnishings.

2. Signs.

3. Fire-fighting devices.

1.02 RELATED WORK SPECIFIED ELSEWHERE.

A. CARPENTRY, MILLWORK, AND RELATED ITEMS -- SECTION 06000: installation.

B. COMPARTMENTS AND CUBICLES -- SECTION 10150

C. TOILET AND BATH ACCESSORIES -- SECTION 10800

1.03 SUBMITTALS.

A. Submit color samples and catalog cuts of items.

1.04 COORDINATION.

A. Provide anchors in ample time when required to be built in by other trades.

PART 2 - PRODUCTS

2.01 MATERIALS.

A. Room name and number signs: white laminated plastic with black engraved numbers; 1-1/2"-high plate; condensed, gothic style numbers. Glue as directed by Owner. Vomar products or equal.

B. Fire extinguisher signs: similar to room name and number signs except with white letters on bright red background. Vertical and horizontal mounting. Sign and color as recommended by Fire Department. Vomar products or equal.

C. Fire-fighting devices: 281 OBC standard extinguisher as indicated by code.

PART 3 - EXECUTION

3.01 INSTALLATION.

A. Install under SECTION 06000 -- CARPENTRY, MILLWORK, AND RELATED ITEMS.

B. After installation, adjust items, tighten, and cut off bolt excess and leave in perfect working order.

C. Maintain protection of installed items until final acceptance.

COMPARTMENTS AND CUBICLES

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE.

A. CARPENTRY, MILLWORK, RELATED ITEMS -- SECTION 06000: installation.

B. MISCELLANEOUS SPECIALTY ITEMS -- SECTION 10050

1.02 REFERENCE STANDARDS.

A. NEMA: National Electrical Manufacturers Association.

1.03 SUBMITTALS.

A. Submit shop drawings before ordering, fabricating, or installing the work of this section.

B. Submit color samples and catalog cuts.

1.04 COORDINATION.

A. Provide anchors in ample time when required to be built in by other trades.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS.

A. Bobrick Washroom Equipment, Inc.

B. Fiat Metal Manufacturing Co., Inc.

C. Sany Metal Products Co., Inc.

D. Other approved as equal.

2.02 MATERIALS AND FABRICATION.

A. Compartments: floor-mounted, overhead-braced type, pre-cut and pre-drilled for hardware and fittings.

B. Doors and partitions: 7/8"-thick, minimum, consisting of 0.062"-thick, high-pressure, laminated plastic which conforms with NEMA standards LP-2, bonded under pressure to all surfaces and edges of a core of exterior A-B grade plywood, particle board, or approved equal, using a thermo-setting plastic resin adhesive applied under continuous heat and pressure until cured.

C. Pilasters: 1-1/4"-thick construction similar to doors and partitions, with adjustable floor anchor with leveling device, studs, and locking nuts to secure pilaster firmly to floor. Parts shall be cadmium-plated or galvanized. Pilasters shall have a 3"-high plinth of 18-8, Type 302 polished stainless steel or chrome-plated brass at floor.

D. Headrails: extruded aluminum, anodized, of anti-grip or manufacturer's standard design, or minimum 1-1/4"x2" plastic laminated solid wood core.

E. Hardware and fittings.

1. Hinges: concealed, recessed, or pivot type (not surface-mounted), adjustable to hold door in preset position. Parts shall be non-rusting, such as stainless steel pintle, nylon, or delrin cams; nylon, delrin or self-lubricating bronze bushing, and chrome-plated brass or other non-ferrous alloy housing.

2. Hinge brackets, stirrup brackets, combination bumper-keeper, combination coat hook-bumper, and all connectors: anodized extruded aluminum alloy, satin finish stainless steel, chrome-plated brass, or other non-ferrous alloy.

3. Latch: chrome-plated brass, stainless steel, or aluminum; slide-operated or operable from outside in emergency.

4. Hardware and fitting fasteners: theft-proof screws or set bolts.

5. Do not use chrome-plated cast zamak (zinc alloy).

PART 3 - EXECUTION

3.01 INSTALLATION.

A. Erect toilet partitions in strict accordance with manufacturer's instructions. Screw or bolt all parts tight and anchor well, true to line, level, and plumb. Place doors and hardware in correct operating condition.

B. Use bolts with lead or steel expansion shields for anchorage to concrete or masonry at grouted cells. Use toggle bolts for anchorage to masonry at ungrouted cells.

C. Install under SECTION 06000 -- CARPENTRY, MILLWORK, AND RELATED ITEMS.

TOILET AND BATH ACCESSORIES

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE.

A. CARPENTRY, MILLWORK, AND RELATED ITEMS -- SECTION 06000: installation.

B. MISCELLANEOUS SPECIALTY ITEMS -- SECTION 10050

1.02 SUBMITTALS.

A. Submit shop drawings before ordering, fabricating, or installing the work of this section.

B. Submit catalog cuts of all items.

1.03 DELIVERY/STORAGE.

A. Deliver materials to jobsite in original sealed containers bearing manufacturer's labels. Store in a manner to prevent damage.

1.04 COORDINATION.

A. Provide anchors in ample time when required to be built in by other trades.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS.

A. Bobrick Washroom Equipment, Inc.

B. Charles Parker Company.

C. Bradley Wash-Fountain Company.

D. Miami Carey Company.

E. F. H. Lawson Company.

2.02 MATERIALS/FABRICATION.

A. Accessories: as described in ACCESSORIES SCHEDULE below. Part numbers indicated are those of Bobrick Washroom Equipment. Similar items of other acceptable manufacturers may be substituted on Architect's approval.

PART 3 - EXECUTION

3.01 INSTALLATION.

A. Install items in accordance with manufacturer's instructions.

B. Locate as indicated on drawings, or if not indicated, as directed by Architect.

C. Install under CARPENTRY, MILLWORK, AND RELATED ITEMS -- SECTION 06000.

3.02 ACCESSORIES SCHEDULE.

A. Toilet tissue dispensers: Bobrick B-288 multi-roll toilet tissue dispenser, 22-gauge (18-8 Type 302) stainless steel, surface-mounted.

B. Mirrors: 1/4" plate glass mirror with concealed mountings.

C. Soap dispensers: Bobrick B-899 liquid soap dispenser, stainless steel, satin finish, 18-gauge wall thickness, 1-1/4" outside diameter.

D. Grab bars: Bobrick B-5507.

E. Grab bar mounting flanges: 11-gauge stainless steel, 3" diameter, each with four stainless steel set screws. Ends of grab bar shall pass through flanges and be heliarc-welded to form one structural unit.

F. Concealed mounting plates for mounting flanges: 13 gauge stainless steel with three slotted screw holes.

1. For stud walls: Bobrick B-5507X, verify with #256 series anchor plate.

2. For solid walls: #2572 series anchor plate.

3. For toilet compartments: #2582 series anchor plate.

DIVISION 11

EQUIPMENT

DIVISION 12

FURNISHINGS

DIVISION 13

SPECIAL CONSTRUCTION

METAL BUILDING SYSTEMS

PART 1 - GENERAL

1.01 WORK INCLUDED.

A. Design, fabricate, and furnish a metal building, including structural framing, roof panels, wall panels, anchor bolts, bracing, fasteners, sealants, insulation, and all other component parts of the metal building.

1.02 RELATED WORK SPECIFIED ELSEWHERE.

A. CAST-IN-PLACE CONCRETE -- SECTION 03300: embedded items.

B. STRUCTURAL STEEL -- SECTION 05120: coordination, erection.

C. METAL DECKING -- SECTION 05300: erection.

D. FLASHING AND SHEET METAL -- SECTION 07600

E. SEALANTS -- SECTION 07900

1.03 BUILDING SYSTEM DESCRIPTION.

A. General design: Type SC prismatic column, clear span, rigid frame, 1-to-12 roof slope, as described in Atlantic Building Systems, Inc. catalog. (Use as a guide only.)

1.04 QUALITY ASSURANCE.

A. The manufacturer shall be regularly engaged in fabrication of pre-engineered metal buildings and shall be a member of the Metal Building Manufacturers Association and the American Institute of Steel Construction.

B. The manufacturer shall have on file certified mill test reports for structural steel which verify that the requirements for minimum yield points have been met.

1.05 REFERENCE STANDARDS.

A. ASTM: American Society for Testing and Materials.

B. AISC: American Institute of Steel Construction, "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings."

C. AISI: American Iron and Steel Institute, "Specification for the Design of Cold Formed Steel Structural Members."

D. AWS: American Welding Society, "Structural Welding Code."

E. MBMA: Metal Building Manufacturers Association, "Recommended Design Practices Manual."

F. Military specifications for sealants.

G. Federal specifications for paint.

1.06 WARRANTY.

A. Furnish manufacturer's written five-year paint warranty for painted steel panels.

PART 2 - PRODUCTS

2.01 MATERIALS.

A. Primary framing: steel with 42,000-psi minimum yield point for built-up framing members; steel with 50,000-psi minimum yield point for cold-formed members.

B. Purlins and girts: hot rolled steel strip with 50,000-psi minimum yield point.

C. Roof and wall panels: steel which conforms with ASTM 446 Grade D, with 1.5-ounce zinc coating. 50,000-psi minimum yield point. Do not use material with a yield point which approaches its own ultimate tensile strength.

D. Insulation: 3" fiberglass blanket with facing, UL-rated not less than .02 perm psf, manufactured by Industrial Insulations, Inc.

E. Fasteners:

1. Structural bolts: ASTM A-325, with hardened washers; at least two bolts at all bolted connections except bracing.

2. Fasteners for attaching steel panels to secondary framing members: self-tapping No. 14 type A, hex head, cadmium-plated carbon steel, assembled with 9/16" O.D., 0.40-thick aluminum washer with bonded neoprene washer, screw head and washer painted to match panels.

3. Fasteners for attaching aluminum and aluminized steel panels to secondary framing member: self-tapping No. 14 stainless steel, Type 305 H3 alloy assembled with a 9/16" O.D., 0.040"-thick aluminum, and bonded neoprene washer.

4. Optional fastener for above self-tapping fasteners:

Self-drilling No. 1232x1", assembled with a 1/2" O.D., 0.040"-thick aluminum, and bonded neoprene washer.

5. Blind fasteners: 5/32"-diameter, high-strength aluminum rivets.

6. Anchor bolts: uncoated steel with 36,000 psi minimum yield point.

F. Sealants.

1. Closure strips: closed cell EPDM elastomer, which meets requirements of ASTM D-1056-64T-FE43 and has the following properties:

Density: not less than 15 pounds per cubic foot.

Water absorption: not more than 2% by volume when immersed 24 hours.

Ultimate tensile strength: 150 psi.

Ultimate elongation: 50% minimum, in accordance with ASTM D-412.

Shrinkage: 3% maximum when exposed to 158 deg. F. for 1000 hours.

Resistance to weathering, sunlight, oxidation, and ozone during prolonged exposure: equal ASTM D-1171 rating 0.

Resistance to cold breakage: no breakage when flexed at -60 deg. F.

2. Panel lap sealer: 3/16" diameter mastic. Mastic shall be a gray elastic compound of synthetic base and asbestos fibrous filler with good adhesion to metal, non-staining, non-corrosive, non-shrinking, non-oxidizing, non-toxic, non-poisonous, non-volatile, with perfomance characteristics which meet or exceed those required in Military Specification MIL-C-18969B, and with the following properties:
Selids content: over 97%.
Service temperature range: -30 deg. F. to +200 deg. F.
Flash point: over 400 deg. F.

3. Gutter sealer: aluminum-pigmented gutter seal.

G. Gutters, trim, and downspouts.

1. Gutters and trim: same material as used for roof or walls, as applicable; minimum 24-gauge steel or minimum 0.032"-thick aluminum. Valley gutters, minimum 18-gauge.

2. Downspouts: minimum 26-gauge steel or minimum 0.032"-thick aluminum, spaced adequately for building size.

2.02 FABRICATION.

A. General:

1. Structural steel design: AISC specifications relating to design requirements and allowable stresses.

2. Cold-formed stuctural steel design: AISI specifications relating to design requirements and allowable stresses.

3. Welding: AWS Code.

4. Design loads: applicable codes. Apply live loads on the horizontal projection of roof in accordance with referenced MBMA manual. Apply wind loads as pressure and suction in accordance with same manual. Design width extension, wall canopy, and roof overhang units for the same load conditions as the building to which they are attached.

B. Primary framing:

1. Rigid frames: construct from rolled beams or continuous automatically-welded plate sections.

2. Post and beam end frames: cold-formed.

3. Base plates, splice plates, and stiffener plates: weld to structural members at manufacturing plant. Do not field-weld primary framing members.

4. Base plates, splice plates and flanges: fabricate to include bolt connection holes. Fabricate webs to include brace rod holes.

C. Secondary framing:

1. Purlins and girts: minimum 7" deep; use continuous-beam design for purlins, simple or continuous-beam design for girts. Form on a continuous rolling mill in the shape of a stiffened flange Z or C section.

2. Bracing for purlins and girts: brace compression flanges for lateral support as required for uplift or outward pressures.

3. Bracing for longitudinal loads: diagonal rods in sidewalls, furnished to length, threaded, and equipped with crescent washers and nuts at each end.

4. Special bracing: furnish as required to remove longitudinal loads when diagonal rod bracing is not permitted in sidewalls.

D. Roof and wall panels:

1. Form AP-1 panels in continuous rolling mill to insure dimensional tolerances. Space major ribs at 12" o.c. and make them 1-3/16" deep and 7/8" wide at top. Place two secondary ribs between major ribs. Provide net panel coverage of 3' - 0". Make panels to overlap one rib. The bottom panel at an overlap shall contain a mastic groove and bear on the purlins or girts.

2. Roof panels shall have a minimum 6" end lap. Use single panels except where lengths become prohibitive and at skylight locations.

3. Make sidewall panels continuous from sill to eave and seal with painted base trim at floor, or seat in a masonry notch.

4. Make endwall panels continuous from sill to roof line except where lengths become prohibitive. Seal with painted base trim at floor or seat in a masonry notch.

E. Gravity ventilators:

1. Furnish 10'-long ridge ventilators to be installed continuous. No more than four 10' units shall be operated from one chain operator.

F. Wall-type skylights.

1. Install translucent skylight panels in same configuration as the AP-1 steel panel. Reinforce with 100% pure fiberglass. Each panel shall contain not less than 25% glass reinforcement and shall have a nominal weight of 8 ounces per square foot.
2. Make panels with high gloss and with no loss of surface gloss nor evidence of exposed fibers after 1000 hours of simulated accelerated weathering in accordance with ASTM Test E42-55T (Type D).

3. Resins shall be highest quality polyester, light stabilized in original manufacturer, modified with not less than 15% acrylic monomer.

4. Texture the exterior surface of panels.

5. Obtain the following panel characteristics:

Flammability rate: not more than 1.5 inches per minute when tested in accordance with ASTM D-635-56T.

Coefficient of heat transmission: no greater than 1.14 BTU/hr/S.F./deg. F.

Coefficient of linear expansion: no greater than 0.000016 in/in/deg. F.

Minimum light transmission: 67% for green, 85% for clear, 28% for white.

G. Stuctural painting.

1. Clean uncoated structural steel and light-gauge steel components of foreign matter and loose scale and give one shop coat of rust-inhibitive zinc chromate iron oxide alkyd primer, formulated to equal or exceed the performance requirements of Federal Specification TT-P-636 C; minimum thickness: 1 mil.

H. Painted steel panels.

1. Preparation of galvanized steeel panels: wash with detergent and pretreat with approved phosphatizing complex chromium oxide pretreatment.

2. Apply 0.1 to 0.2 mils of epoxy primer, by roll coater method to provide suitable surface for application of finish coat. Bake primer to minimum metal temperature of 310 deg. F.

3. Apply 1 mil (dry film thickness) finish coat of weather-resistant silicone polyester and bake to minimum metal temperature of 450 deg. F. Use fade-resistant color pigments. Painted panels shall have a 60-degree gloss of 30 (+/-8) when measured according to ASTM D-523.21, and shall not show excessive chalking, cracking, checking, or loss of adhesion during warranty period. Color change shall not exceed an average of seven points when measured in accordance with ASTM D-2244-64T.

PART 3 - EXECUTION

3.01 ERECTION.

A. Follow specifications found under STRUCTURAL STEEL -- SECTION 05120, and METAL DECKING -- SECTION 05300.

DIVISION 14

CONVEYING SYSTEMS

DIVISION 15

MECHANICAL

PLUMBING SYSTEMS

PART 1 - GENERAL

1.01 WORK INCLUDED.

A. Installation of sanitary drain and roof drain systems.

B. Installation of cold and hot water system, including water heater

C. Installation of plumbing fixtures.

D. Trenching and backfilling.

E. Sterilization of water lines.

1.02 RELATED WORK SPECIFIED ELSEWHERE.

A. CAST-IN-PLACE CONCRETE -- SECTION 03300

B. CARPENTRY, MILLWORK, AND RELATED ITEMS -- SECTION 06000

C. SERVICE AND DISTRIBUTION -- SECTION 16400

1.03 SYSTEM DESCRIPTION.

A. Location of pipes and fixtures indicated on drawings is approximate. Lay out system to insure neat, systematic, and orderly arrangement of work. Erect vertical lines plumb; erect grouped lines parallel and as direct as possible. Run exposed pipe parallel to walls. Keep pipes as close to underside of floor slab as possible.

1.04 QUALITY ASSURANCE.

A. Install plumbing in accordance with UPC, Fire Marshal's requirements, Department of Health requirements, Title 24, and other applicable codes. Obtain permits and licenses as required.

1.05 PREFERENCE STANDARDS.

A. UPC: Uniform Plumbing Code.

1.06 SUBMITTALS.

A. Submit shop drawings showing all work. Indicate conflicts with work specified in other sections. Do not begin the work of this section until this submittal is approved.

B. Submit a complete schedule of materials and equipment proposed for installation. Do not install materials and equipment until this submittal is approved.

C. Keep up-to-date one set of prints which indicate system layout as installed.

D. Submit as-built drawing of system upon completion of work of this section.

1.07 COORDINATION.

A. Coordinate work of this section with other work and check other work for clearances, adequacy, location, and structural interference before installation.

B. Perform cutting and patching of work of other sections as specified under those sections.

1.08 WARRANTY.

A. Warrant plumbing system against failure for one year from date of acceptance.

B. Warrant premises against damage caused by leaks in pipes or fixtures furnished under this section for one year from date of acceptance.

PART 2 - PRODUCTS

2.01 MATERIALS.

A. Underground soil, waste and vent pipes: service-weight hub and spigot, hot asphaltum-coated cast iron.

B. Above-ground waste and drain pipes, 2-1/2" and under: coated cast iron drainage pattern.

C. Above-ground vent pipes, 2-1/2" and under: standard galvanized steel pipe with galvanized malleable iron fittings.

D. Above-ground waste, drain, and vent pipes over 2-1/2": service-weight hub and spigot hot asphaltum-coated cast iron.

E. Joints: Ty-Seal joints may be used below ground. Use no-hub joints only above ground.

F. Floor cleanout access cover and frame: scoriated, polished brass; Josam Y-320-XFB or equal.

G. Sleeve for wall cleanout: 24-gauge, galvanized, 2" larger diameter than pipe at wall cleanout access.

H. Vent roof flashing: 4-pound sheet lead. Base flashing to extend at least 10 feet out around pipe with tight-fitting leak collar extending up and turned in at top.

I. Water pipes above ground: hard-drawn Type L copper pipe.

J. Water pipes below ground: hard-drawn Type K copper pipe.

K. Water fittings: wrought copper or cast bronze.

L. Copper pipe joint solder: 95-5 solder.

M. Gate valve for solder joint: 125-pound bronze, Crane No. 1320 or equal; non-rising stem.

N. Gate valve for screwed joint: Crane No. 438 or equal; non-rising stem.

O. Check valve: 125-pound bronze, horizontal lift check type.

P. Clamps, hangers, concrete inserts for hanger attachment: as approved.

Q. Straps for copper tubing: copper, brass, or copper plate.

R. Fixtures: as specified below in fixture schedule.

PART 3 - EXECUTION

3.01 INSPECTION.

A. Inspect all piping inside and out before installation and allow no obstructions or burrs.

B. Do not close up, fur in, bury, or otherwise hide any pipe until it has been inspected, tested, and approved by proper authorities.

3.02 PREPARATION.

A. Taper-ream all pipe ends to full I.D. and remove all burrs.

B. Close pipe openings with caps or plugs during installation. Cover fixtures and equipment tightly and protect against dirt, water, chemical, and mechanical injury.

C. Handle exposed piping carefully to avoid excessive tool marking. Handle polished fittings with extra care so that tool marks do not show.

3.03 INSTALLATION.

A. Perform excavation and backfill in accordance with U.P.C. Provide proper support along pipe length where rocks are

encountered. Bury pipes at least 24" below grade. Run ditches parallel to footings not less than 3'-0" from footings. Conform with specifications in CAST-IN-PLACE CONCRETE -- SECTION 03300 for concrete work.

B. No plumbing fixture, device, or piping shall provide a cross-connection or interconnection between a distributing supply for drinking or domestic purposes and polluted supply such as soil or waste pipe, which could make possible any back-flow of sewage, polluted water, or waste into the water supply system.

C. Install exposed piping in one length where possible.

D. Install fittings in walls, under counters, or within furred spaces.

E. Slope sanitary piping at least 1/4" per foot of horizontal run.

F. Grade vent pipes to expel water. Extend vents through roof at least 12" above roofing.

G. Run drain pipes with easy bends and long radius turns. Make offsets at angles of 45 degrees or less, except where cleanouts are provided for shorter turns.

H. Provide branch water lines with a 12"-long air chamber. Make air chambers in branches to individual fixtures of same size pipe as branch pipe and install in end of branch line. Make air chambers in branches which serve a battery of fixtures two pipe sizes larger than the branch supply main and install in similar location.

I. Provide pipe sleeves for underground pipes which pass through walls and make watertight at sleeves. Provide sheet metal thimbles where pipes pass through floor or non-structural members. Provide steel pipe sleeves where pipes pass through structural members. Provide galvanized sheet metal thimbles where pipes pass through masonry walls.

J. Anchor piping in building with clamps or adjustable hangers spaced in accordance with U.P.C. Where copper contacts ferrous materials, wrap with two layers of plastic tape.

K. Install hose bibbs approximately 18" above floor or as indicated on drawings.

L. Install cleanouts in accordance with U.P.C. Sections 406 and 1107.

M. Provide dielectric unions where copper piping is connected to ferrous pipe.

N. Sweat solder joints in copper piping.

3.04 TESTS AND CLEANUP.

A. Test sanitary and water piping in accordance with U.P.C. Furnish all equipment for tests and pay all costs of repair and damage resulting from such tests. Perform tests in presence of, and to satisfaction of, plumbing inspector and Architect.

B. Clean work, including fixtures, thoroughly and leave ready for use.

3.05 PLUMBING FIXTURE SCHEDULE.

A. Water closet:

1. Kohler K-4282-ET "Penryn" syphon jet, elongated, floor-mounted water closet with 1-1/2" top spud.

2. Sloan 111-FYV-YO "Royal" flush valve with vacuum breaker, bumper on valve, screwdriver stop.

3. Olsonite 10SS, white, solid plastic open-front seat with self-sustaining hinge, seatless cover.

4. Brass closet bolts, nuts, washers, and china bolt caps.

B. Paraplegic water closet:

1. Kohler K-4268-ET 18" high, syphon-jet, elongated, paraplegic floor-mounted water closet with 1-1/2" top spud.

2. Sloan 110-FYV-YYO "Royal" flush valve with vacuum breaker, bumper on valve, screwdriver stop.

3. Olsonite 10SS solid, white plastic, open-front seat with self-sustaining hinge, less cover.

4. Brass closet bolts, nuts, washers, and china bolt caps.

C. Lavatory-oval:

1. Kohler K-2910, acid-resisting, enameled cast iron, with metal frame.

2. Kohler K-7510 sentinel faucet with Synchro drain and chrome faucet hole cover.

3. Kohler K-7606 angle stop.

4. Kohler K-9000 1-1/2" P-trap with tubing outlet and wall flang

e.

D. Urinal:

1. Kohler K-4980-T vitreous china, wall-hung urinal with 3/4" top spud, 2" IPS outlet, and stainless steel beehive strainer.

2. Sloan 186 "Royal" flush valve with vacuum breaker and screwdriver stop.

3. J. R. Smith Fig. No. 636 urinal support.

E. Service sink:

1. Kohler K-6716 22"x18" acid-resisting, enameled cast iron service sink with stainless steel rim guard.

2. Kohler K-7871 sink faucet with 3/4" hose and connection, blade handle indexed "C".

3. J. R. Smith Fig. No. 9110 2" acid-resisting porcelain, enameled inside trap, standard with chrome-plated strainer, rubber gasket, and brass cleanout plug.

4. Kohler K-7732 chrome-plated faucet hole cover.

5. Price-Pfister 13-210 1/2" concealed partition stop with cross handle.

F. Drinking Fountain:

1. "Elkay" Model No. ESW-85, simulated semi-recessed water cooler, high-back integral backsplash. Mounted flush-to-wall, swirl-flo basin with combined bubbler and self-closing push-button control. Pump with 1/5 HP and amps rated at 5.3. 3/4" I.P.S. water supply and 1-1/4" I.P.S. drain.

G. Floor drain:

1. J. R. Smith Fig. No. 22010-A cast iron-body floor drain with 5" round, nickel-bronze strainer; threaded or caulk outlet to suit installation.

H. Floor drain with funnel:

1. J. R. Smith Fig. No. 3510 2" cast iron-body floor drain with 5" round, nickel-bronze strainer head and funnel; threaded or caulk outlet to suit installation.

I. Interior hose bibb:

1. Price-Pfister 87-020 1/2" solid flange, rough chrome hose bibb with tamper-proof lock shield and loose key.

2. Price-Pfister 13-210 partition stop.

J. Exterior hose bibb:

1. Price-Pfister 83-510 3/4" rough brass, loose-key hose bibb.

2. P. P. 107-430 3/4" rough brass, square-head service cock.

AIR DISTRIBUTION

PART 1 - GENERAL

1.01 WORK INCLUDED.

A. Install air-handling units and condensing units.

B. Install exhaust fans and power roof ventilator.

C. Install ductwork, air outlets, roof caps, flashing.

D. Install refrigerant and condensate drain piping.

E. Install controls and control wiring.

F. Furnish starters.

G. Install insulation.

H. Test and balance system.

1.02 RELATED WORK SPECIFIED ELSEWHERE.

A. SERVICE AND DISTRIBUTION -- SECTION 16400: power wiring, starter installation.

1.03 SYSTEM DESCRIPTION.

A. The drawings are essentially diagrammatic, indicating general layout and approximate locations. Reasonable modifications to indicated locations and arrangement to suit job conditions shall be anticipated. Where apparatus and equipment have been indicated on the drawings, dimensions have been taken from typical equipment of the class indicated.

1.04 QUALITY ASSURANCE.

A. Obtain and pay for all permits and licenses.

B. Comply with all laws, ordinances, rules, and regulations

which bear on conduct of work.

1.05 REFERENCE STANDARDS.

A. ASHRAE: American Society of Heating, Refrigeration, and Air Conditioning Engineers, "Handbook of Fundamentals."

1.06 SUBMITTALS.

A. Submit manufacturer's detailed data for equipment.
B. Submit mechanical equipment shop drawings.

C. Submit to-scale drawings and isometric diagrams of proposed layout of air conditioning system, indicating details of construction and installation of particular equipment furnished. Drawings shall be fully-dimensioned, showing that equipment and connections fit the space provided.

D. Submit as-built drawings upon completion of work of this section.

E. Submit completed certificate of inspection upon completion of project.

PART 2 - PRODUCTS

2.01 MATERIALS AND FABRICATION.

A. Ductwork: galvanized mild steel, size increased to accommodate insulation.

B. Fresh air registers: aluminum, 5/8" margin, rubber gasket, baked-enamel finish, horizontal face bars, opposed blade damper. Tuttle and Bailey Series NT 110 or equivalent series of Carnes or Anemostat, or approved equal.

C. Refrigerant piping: hard-drawn copper, Type K.

D. Condensate drain piping: hard-drawn copper, Type L.

E. Duct insulation: 1" coated fiberglass, 3-pound density. Owens-Corning Aeroflex Duct Liner, Type 300, equivalent model of Gustin-Bacon or Johns-Mansville, or approved equal.

F. Suction line and condensate drain line insulation: 3/4" Armaflex insulation or equal.

2.02 EQUIPMENT.

A. Air-handling units:

1. Cooling coils: non-ferrous construction with mechani-

cally-bonded smooth plate fins. Designed for use with R-22 refrigerant.

2. Evaporator fan section: forward-curved double inlet fan mounted on common shaft, statically and dynamically balanced, run on factory-lubricated bearings with V-belt drive on a variable pitch pulley.

3. Casing: welded angular frame.

4. Filters: 1/2"-thick, throw away type.

B. Condensing units:

1. Factory-assembled and tested for use with KR-22 refrigerant.

C. Ceiling-mounted exhaust fans: Penn Zephyr Series Z or equal, with capacities and maximum sound levels as indicated on drawings.

D. Power roof ventilator: Carnes ERBA series or equal, with capacities and maximum sound levels as indicated on drawings.

PART 3 - EXECUTION.

3.01 INSTALLATION.

A. Perform all work in accordance with approved drawings and in accordance with ASHRAE procedures.

B. Furnish vaned elbows for supply and return duct work.

C. Furnish and install a double layer of 16-oz. asbestos cloth at suction and discharge connection of air-handling units.

D. Cement and fasten duct liner in accordance with manufacturer's recommendations.

DIVISION 16

ELECTRICAL

SERVICE AND DISTRIBUTION

PART 1 - GENERAL

1.01 WORK INCLUDED.

A. Install underground service entrance raceways for electric and telephone utility service.

B. Install lighting, general-use receptacle, and special outlet systems.

C. Install power wiring and connection to air conditioning and ventilation equipment.

D. Test installation. Remove and replace faulty items.

1.02 RELATED WORK SPECIFIED ELSEWHERE.

A. PAINTING -- SECTION 09900

B. AIR DISTRIBUTION -- SECTION 15800

1.03 QUALITY ASSURANCE.

A. Obtain and pay for construction permit and arrange for periodic inspection by local authorities.

B. Perform all work in accordance with local ordinances, requirements of State Fire Marshall, NBFU, and specifications of NEMA and IEEE.

C. Conform with construction practices as recommended by American Electrician's Handbook by Croft and with instructions of manufacturers of equipment and materials supplied for this work.

D. Afford Architect every opportunity to determine that skill and accuracy characterizes the work. Anticipate Architect's random reopening of concealed work during final inspection.

1.04 REFERENCE STANDARDS.

A. NBFU: National Board of Fire Underwriters.

B. NEMA: National Electrical Manufacturer's Association.

C. IEEE: Institute of Electrical and Electronics Engineers.

D. NEC: National Electrical Code.

1.05 SUBMITTALS.

A. Submit shop drawings or catalog cuts of following equipment.

1. Metering equipment.

2. Panel boards.

3. Lighting fixtures.

4. Any built-to-order equipment.

B. Submit as-built drawings after final inspection.

C. Submit certificate of final inspection.

1.06 COORDINATION.

A. Coordinate the work of this section with other sections to avoid omissions and overlapping responsibilities.

B. Notify other trades and suppliers of project voltages.

C. Obtain requirements for raceways, grounding, and protection for telephone system from Telephone Company. Cables, stations, equipment, and accessories furnished by Telepone Company.

D. Obtain requirements for service raceway grounding and for metering from Electric Company. Service cables, final connection, and metering equipment furnished by Electric Company.

E. Arrange and pay utility companies for service charges and work performed by them.

1.07 WARRANTY.

A. Warrant the work of this section to be free from defects in material and workmanship for a period of one year after final acceptance.

PART 2 - PRODUCTS

2.01 MATERIALS AND FABRICATION.

A. Boxes: galvanized, pressed steel, with matching extension ring when required, 4" square by 1-1/2" deep minimum. Manufacture in accordance with NEC Article 370.

B. Wires: 600 volts, No. 12 AWG minimum, copper conductored, TW, No. 4 and larger THW or XHHW. Manufacture in accordance with NEC Articles 300 and 310.

C. Light fixtures: as specified in FIXTURE SCHEDULE. Provide necessary lamps, ballasts, starters, and mounting accessories. Manufacture in accordance with NEC Article 410.

D. Conduits or electrical tubing: galvanized, 1/2" minimum inside diameter (unless otherwise indicated), round bore electrical conduit with threaded fittings. Do not use aluminum conduits. Manufacture in accordance with NEC Articles 346 and 348.

E. Flexible conduits: flexible steel, zinc-coated, 1/2" minimum with factory-approved fittings. In wet locations, use liquid light type, jacketed with polyethylene. Manufacture in accordance with NEC Articles 350 and 351.

F. Switches: single-pole or three-way, 15 amperes, nonmercury quiet, 120-277 volts, flush tumbler, AC type. Bryant Company No. 110X-1 series, or approved equal.

G. Duplex receptacles: 20 amperes, 125 volts, 3 wires, grounding type, Bryant Company No. 5252-1, or approved equal.

H. Telephone outlet: consists of outlet box, extension ring, and device plate with 7/16" diameter hole for telephone cable.

I. Device plates: ivory bakelite plastic, smooth-finish. When more than one switch or device at single location, use gang plate. Bryant Electric Company 72XXX series, or approved equal.

J. Individual circuit breaker: molded plastic case circuit breaker with toggle operated mechanism, thermal-magnetic overload trips; interchangeable trip when available. Toggle positions "ON", "TRIPPED" and "OFF" engraved on body or toggle. Enclose in NEMA style box. Manufacture in accordance with NEC Article 240. Use breakers manufactured by Westinghouse, Federal Pacific, Square-D, or Cutler Hammer Electric.

K. Equipment disconnect and fused switch: heavy-duty fusable or non-fusable safety switch; horsepower-rated when used as motor disconnect. Contacts shall be lever-operated, spring-loaded and enclosed in NEMA 1 enclosure for interior locations and NEMA 3R enclosure for exterior locations. Use rejection-type clips with current limiting type fuses. Manufacture in accordance with NEC Articles 240, 380 and 430. Use Westinghouse No.HF and HU series, or approved equal of Federal Pacific Company or Square-D Company.

L. Current-limiting fuses: 600 volts NEMA class H, silver link and silvered copper end cap or blades. For each current-rating, furnish six spare fuses. Fuse shall coordinate with circuit breaker to provide protection during high-fault currents in accordance with Chase-Shawmut bulletin A-T 619, Chase-Shawmut Co., No. class J. Amp-trap.

M. Gutters: square or rectangular cross section, galvanized, prime-painted and enamel-finished. Manufacture in accordance with NEC Articles 362 and 374.

N. Enclosures and cabinets for panel boards, beakers, and switches: NEMA 1 type for interior locations, NEMA 3R type for exterior locations, galvanized steel, prime-painted and enamel-finished in accordance with NEMA specifications. Manufacture in accordance with NEC Article 373.

O. Hardware, supports, backing, etc:

1. Wood materials: Wolmanize-treat against termites.

2. Iron or steel materials: galvanized.

3. Non-ferrous metals: brass or bronze.

4. Wood screws: brass or galvanized steel.

P. Panel boards: copper or aluminum-bussed and bolted, molded plastic case circuit breaker complement. Enclosure shall be galvanized steel with hinged door, latch, lock, two keys, circuit directory in metal frame, with complete circuit assignment typed neatly, 4" minimum side gutters and 5" minimum top and bottom gutters. Manufacture in accordance with NEC Articles 240 and 384. General Electric, Square-D, Westinghouse, Cutler Hammer, or approved equal.

Q. Motor connection: includes weatherproof, flexible conduit, flexible motor lead wires, grounding, and suitable lock-nut type of threaded connector.

R. Name plates: laminated plastic, black-white, engraved with 3/16" high commercial letters to expose white, screw-mounted.

PART 3 - EXECUTION

3.01 INSTALLATION.

A. Ground motors, metallic enclosures, raceways, and electrical equipment in accordance with NEC Article 250.

B. Attach electrical equipment to wood, using wood screws; attach to concrete by embedded or expansion inserts and bolts. Use powder-charge driving only with approval.
C. Install boxes in accordance with NEC Article 370.
D. Install wires in accordance with NEC Article 310.
E. Install light fixtures in accordance with NEC Article 410.
F. Install conduits or electrical metal tubing in accordance
G. Install flexible conduits in accordance with NEC Articles 350 and 351.
H. Install circuit breakers in accordance with NEC Article 240.
I. Install equipment disconnect and fused switch in accordance with NEC Articles 240, 380, and 430.
J. Install gutters in accordance with NEC Articles 362 and 374.
K. Install enclosures and cabinets for panel boards, breakers, and switches in accordance with NEC Article 373.
L. Install panel boards in accordance with NEC Articles 240 and 384.
M. Patch, repair, and restore structural or architectural elements cut or drilled for installation of the work of this section.
N. Close unused knockouts on boxes or enclosures with metal cap.
O. Wipe exposed raceways and enclosures clean with rag and solvent. Unfinished raceways and enclosures shall be prime-painted and finished as specified under PAINTING -- SECTION 09900.
P. Identify panel boards with name plates.
Q. Stencil voltage ratings on front of disconnect switches and junction boxes where wires are terminated for connection to equipment that is not a part of contract.
R. Install name plates on feeder breakers, switches, cabinets, and large junction boxes as follows:
   1. Feeders: by panels or loads served.
   2. Panels: by designation, voltage, phases, wires.
   3. Cabinets: by use.
   4. Boxes: by use and voltage.